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TRANSLATION

I, Yuko Mitsui, residing at 4-6-10, Higashikoigakubo, Kokubunji-shi, Tokyo, Japan, state:

that I know well both the Japanese and English languages,

that I translated, from Japanese into English, Japanese Patent Application No. 2002-265724, filed on September 11, 2002, and

that the attached English translation is a true and accurate translation to the best of my knowledge and belief.

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Yuko Mitui

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[Title of the Invention] ENDOSCOPE APPARATUS

[What is Claimed is:]

[Claim 1] An endoscope apparatus characterized by comprising:

a scope unit including:

an elongate insertion portion having flexibility to be inserted into an inspection object space,

an observation unit for observation disposed in a tip end of the insertion portion,

a curved portion which bends the tip end of the insertion portion in an arbitrary direction, and

a base unit connected to a base end of the insertion portion; and

a fixed unit to which the base unit of the scope unit is detachably connected,

characterized in that

a fixed connector is provided in a standard position in at least one of a connector on the side of the scope unit and a connector on the side of the fixed unit in a connector portion disposed in a detachable portion of the base unit and the fixed unit, and a movable connector is provided in the other one of the connector on the side of the scope unit and the connector on the side of the fixed unit, the movable connector having a play portion for permitting the backlash between both the connectors at the time of the attachment/detachment with respect to the fixed connector, and

axial alignment means is provided to carry out axial

alignment between the fixed connector and the movable connector at the time of the connection.

[Claim 2] The endoscope apparatus according to claim 1, characterized in that the detachable portion includes positioning means for positioning a connected position of the fixed unit side and the base unit side, when the connector on the fixed unit side is connected to that on the base unit side.

[Claim 3] The endoscope apparatus according to claim 2, characterized in that the positioning means includes a receiving member including a tapered fitting hole portion in at least either one of the base unit and the fixed unit, and a protrusion which is to fit into the fitting hole portion of the receiving member in the other.

[Claim 4] The endoscope apparatus according to claim 1, characterized in that

the connector portion includes an optical connector portion for optical connection, and a electric connector portion for electric connection, and

the axial alignment means is provided in at least one of the optical connector portion and the electric connector portion.

[Claim 5] The endoscope apparatus according to claim 1, characterized in that

the connector portion includes at least an electric connector portion for electric connection, and

the electric connector portion includes the axial alignment means.

[Claim 6] The endoscope apparatus according to any one of

claims 4 and 5, characterized in that the electric connector portion includes connection detection means for using some of a plurality of connector pins disposed on a connector main body to detect connection of the scope unit.

[Claim 7] The endoscope apparatus according to claim 1, characterized in that

a plurality of different types of scope units are disposed beforehand,

the base unit of any one of the plurality of scope units is selectively and detachably connected to the fixed unit,

the base unit includes a first control circuit, and the fixed unit includes a second control circuit, and

the first control circuit stores scope information for measurement to identify a type and individual piece of the scope unit, and the second control circuit includes scope information read means for reading the scope information.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to an endoscope apparatus which is used mainly in an industrial field and which is inserted into an inspection object space such as a pipe to observe the inside of the inspection object space, and the like.

[0002]

[Prior Art]

As a general endoscope apparatus, a constitution described, for example, in Pat. Document 1 is known. In this publication, an operation portion on a hand side is connected to a base end

of an elongate insertion portion inserted into the inspection object space. Furthermore, an observation optical system including an image pickup device for observation, an illuminating window for irradiation with an illuminative light, and the like are disposed in a tip end of the insertion portion.

[0003]

Moreover, the operation portion is connected to one end of a universal cable, which includes a light guide for transmitting the illuminative light, a signal line for transmitting a signal output from the image pickup device, and the like. The other end of the universal cable is connected to a connector portion. The connector portion is detachably connected to an external apparatus including a light source apparatus or a camera control unit (CCU).

[0004]

An elastically supported socket is disposed in the light source apparatus. The connector portion of the universal cable is inserted and connected into the socket, and in this state a connected portion of the connector portion and the socket is elastically supported.

[0005]

[Pat. Document 1]

Jpn. Pat. Appln. KOKAI Publication No. 7-181400

[0006]

[Object of the Invention]

Furthermore, a fixed unit which is usable in common in a plurality of types of endoscope apparatuses is disposed. Some of members of an external peripheral apparatus are mounted on

the fixed unit. A system is proposed in which the fixed unit is combined and used with a plurality of types of scope units of the endoscope apparatus.

[0007]

In the apparatus having the above conventional constitution, however, when the position of the connector portion does not agree with that of the socket because of fluctuation by assembly during manufacturing, there is a problem that the scope unit cannot be attached/detached with respect to the fixed unit. Furthermore, when the scope units cannot securely be positioned with respect to the fixed unit, loss of an illuminative light amount, or contact defect of an electric contact is caused, and original capabilities possessed by machines cannot be fulfilled in some case. Moreover, breakage is sometimes caused in a connected portion by vibration or impact. Therefore, since assembly accuracy has to be enhanced, e.g., manufacturing cost is raised.

[0008]

The present invention has been made in view of the foregoing circumstances, and it is an object of the invention to provide an endoscope apparatus which can be used by combining a fixed unit with a plurality of types of scope units of external apparatus, thus enabling a sufficient performance to be exhibited through the compatibility and secure connection.

[0009]

[Means for Achieving the Object]

The invention described in claim 1 is an endoscope apparatus, which is characterized by comprising:

a scope unit including:

an elongate insertion portion having flexibility to be inserted into an inspection object space,

an observation unit for observation disposed in a tip end of the insertion portion,

a curved portion which bends the tip end of the insertion portion in an arbitrary direction, and

a base unit connected to a base end of the insertion portion; and

a fixed unit to which the base unit of the scope unit is detachably connected,

in which

a fixed connector is provided in a standard position in at least one of a connector on the side of the scope unit and a connector on the side of the fixed unit in a connector portion disposed in a detachable portion of the base unit and the fixed unit, and a movable connector is provided in the other one of the connector on the side the scope unit and the connector on the side of the fixed unit, the movable connector having a play portion for permitting the backlash between both the connectors at the time of the attachment/detachment with respect to the fixed connector, and

axial alignment means is provided to carry out axial alignment between the fixed connector and the movable connector at the time of the connection.

[0010]

According to the invention of claim 1, when the movable connector is connected to the fixed connector in a standard

position, which is provided in one of the connector on the side of the scope unit and that on the side of the fixed unit in a connector portion disposed in a detachable portion of the base unit of the scope unit and the fixed unit, the play portion of the movable connector permits the backlash between both the connectors at the time when the movable connector is attached/detached with respect to the fixed connector, so that the axial alignment means can carry out axial alignment between the fixed connector and the movable connector.

[0011]

The invention described in claim 2 is an endoscope apparatus according to claim 1, which is characterized in that the detachable portion includes positioning means for positioning a connected position of the fixed unit side and the base unit side, when the connector on the fixed unit side is connected to that on the base unit side.

[0012]

According to the invention of claim 2, when the connector on the fixed unit side is connected to that on the base unit side, the positioning means provided in the detachable portion for the base unit of the scope unit and the fixed unit can determine the connected position of the fixed unit side and the base unit side.

[0013]

The invention described in claim 3 is an endoscope apparatus according to claim 2, which is characterized in that the positioning means includes a receiving member including a tapered fitting hole portion in at least either one of the base

unit and the fixed unit, and a protrusion which is to fit into the fitting hole portion of the receiving member in the other.

[0014]

According to the invention of claim 3, a tapered fitting hole portion of a receiving member provided in at least one of the base unit and the fixed unit is fitted into by the protrusion of the other, so that the connected position of the fixed unit side and the base unit side is determined.

[0015]

The invention described in claim 4 is an endoscope apparatus according to claim 1, which is characterized in that the connector portion includes an optical connector portion for optical connection, and an electric connector portion for electric connection, and

the axial alignment means is provided in at least one of the optical connector portion and the electric connector portion.

[0016]

According to the invention of claim 4, the axial alignment means provided in at least one of the optical connector portion and the electric connector portion carries out axial alignment between the fixed connector and the movable connector.

[0017]

The invention described in claim 5 is an endoscope apparatus according to claim 1, which is characterized in that the connector portion includes at least an electric connector portion for electric connection, and

the electric connector portion includes the axial alignment

means.

[0018]

According to the invention of claim 5, the axial alignment means provided in the electric connector portion for electric connection carries out axial alignment between the fixed connector and the movable connector.

[0019]

The invention described in claim 6 is an endoscope apparatus according to any one of claims 4 and 5, which is characterized in that the electric connector portion includes connection detection means for using some of a plurality of connector pins disposed on a connector main body to detect connection of the scope unit.

[0020]

According to the invention of claim 6, the connection detection means provided in the electric connector portion carries out connection detection of the scope unit using some of a plurality of connector pins disposed on the connector main body.

[0021]

The invention described in claim 7 is an endoscope apparatus according to claim 1, which is characterized in that a plurality of different types of scope units are disposed beforehand,

the base unit of any one of the plurality of scope units is selectively and detachably connected to the fixed unit,

the base unit includes a first control circuit, and the fixed unit includes a second control circuit, and

the first control circuit stores scope information for measurement to identify a type and individual piece of the scope unit, and the second control circuit includes scope information read means for reading the scope information.

[0022]

According to the invention of claim 7, the base unit of any one of a plurality of types of scope units disposed beforehand is selectively and detachably connected to the fixed unit, the scope information for measurement stored in the first control circuit of the base unit identifies a type and individual piece of the scope unit, and the first control circuit of the base unit and the second control circuit of the fixed unit control measurement function of the endoscope apparatus.

[0023]

[Embodiments of the Invention]

A first of the present invention will hereinafter be described with reference to FIGS. 1 to 22. FIG. 1 shows a schematic constitution of a whole system of an endoscope apparatus 1 which is used in industry of an embodiment of the present invention. The system of the endoscope apparatus 1 is constituted of: a scope unit 2 in which a plurality of different types of machines are disposed beforehand; and one fixed unit 3 usable in common with a plurality of types of scope units 2.

[0024]

Furthermore, as shown in FIG. 2, the scope unit 2 includes an elongate insertion portion 4a which is to be inserted into at least an inspection object space and which has flexibility; an intermediate connection portion 4b; a universal cable 4c; and a

base unit 4d. Here, the insertion portion 4a is disposed in an endmost position, and is constituted of: a head portion 4a1 in which an observation optical system for observation, an illuminating optical system, and the like are incorporated; a curved portion 4a2 which can remotely be bent/operated; and an elongated flexible tube portion 4a3. Moreover, the curved portion 4a2 is disposed between the head portion 4a1 and the flexible tube portion 4a3.

[0025]

Moreover, in a tip-end surface of the head portion 4a1, as shown in FIG. 16, an illuminating window 104 for the illuminating optical system, an observation window 106 for the observation optical system, a tip-end opening 101 of an inner channel (treatment instrument insertion path) 102 disposed inside the insertion portion 4a, and the like are disposed. Furthermore, inside the insertion portion 4a, a light guide for transmitting an illuminative light into the illuminating window, a signal line connected to solid image pickup devices such as a CCD disposed in the observation optical system, a plurality of, four in the present embodiment, angle wires (operation wires) for bending/operating the curved portion 4a2, and the like are arranged.

[0026]

In this example, two angle wires for vertical curve operation, and two angle wires for left/right curve operation are arranged. Moreover, the curved portion 4a2 of the insertion portion 4a is pulled/operated in a vertical direction by two angle wires for the vertical curve operation and in a left/right

direction by two angle wires for the left/right curve operation, and can be bent/deformed in four directions including the vertical and left/right directions, and an arbitrary direction obtained by combining these directions.

[0027]

Moreover, a base end of the flexible tube portion 4a3 of the insertion portion 4a is connected to the tip end of the intermediate connection portion 4b. The intermediate connection portion 4b includes a grip portion 4b1 which can be grasped with one hand by a user as shown in FIG. 2. In a rear end of the grip portion 4b1, a channel port portion 4b2 and a connection portion to the tip end of the universal cable 4c are juxtaposed. Furthermore, inside the universal cable 4c, a light guide extended from the insertion portion 4a side, the signal line, four angle wires, and the like are arranged.

[0028]

Furthermore, the base end of the universal cable 4c is connected to the base unit 4d. For the base unit 4d, as shown in FIG. 1, inside a unit case 4d1, an angle driving section (curve control mechanism) 5, and an angle and CCD control circuit 6 are built. Here, in the angle driving section 5, as shown in FIG. 4(C), a tractive force transmission mechanism unit 5a, and two motor units 7 for the vertical curve operation and left/right curve operation, respectively, are constituted. Furthermore, in the angle and CCD control circuit 6, a control circuit of an image pickup device constituting a camera control unit (CCU), a curve control circuit for controlling the operation of the angle driving section 5, a circuit relay

substrate, and the like are built.

[0029]

For the fixed unit 3, a unit case 3a contains a power supply unit 8, light source unit (lamp) 9, system control circuit 10, lamp lighting circuit, circuit relay substrate, and the like. Furthermore, the system control circuit 10 can be connected to an operation remote controller 11 for operating the endoscope apparatus 1, and a monitor 12 which performs display.

[0030]

Moreover, as shown in FIG. 3, in the unit case 3a of the fixed unit 3, a scope unit connection portion 3b is formed to which the base unit 4d of the scope unit 2 is detachably connected and which has a concave shape. In the scope unit connection portion 3b, a scope unit connection surface 3b1 which abuts on an end plate (housing panel) 4d2 of the unit case 4d1 in the base unit 4d of the scope unit 2, and a scope unit contact surface 3b2 which contacts a side plate 4d3 of the unit case 4d1 are arranged. Here, the scope unit connection surface 3b1 is formed by a lamp housing 9a of the light source unit 9 in the fixed unit 3.

[0031]

Moreover, as shown in FIGS. 4(A), 4(B), and 5, in the side plate 4d3 of the unit case 4d1 of the base unit 4d, two upper and lower protrusion-shaped resin slider members 13 which guide movement of the base unit 4d at the time of connection with respect to the fixed unit 3 are extended substantially along a horizontal direction. Here, in the fixed unit 3, guide rails 14 formed of a metal are disposed to guide the movement of the

slider members 13. As shown in FIG. 6, in an inner surface of the guide rail 14, a dovetail groove 14a is formed which has tapered surfaces 14a1 engaging with the slider member 13.

[0032]

Moreover, as shown in FIG. 4(A), the slider members 13 are screwed/fixed to the side plate 4d3 of the unit case 4d1. Furthermore, as shown in FIG. 6(A), vertically extended projecting portions 15 are disposed on opposite upper/lower ends of each slider member 13. On the inner surfaces of the respective projecting portions 15, engaging surfaces 15a having tapered surface shape are formed to fit into the dovetail groove 14a of the slider member 13.

[0033]

Furthermore, in opposite front/rear ends of each slider member 13, as shown in FIG. 6(B), chamfered portions 16 obtained by largely cutting the end surface portion are formed so that the member is easily inserted into the dovetail groove 14a constituting the guide rail 14. Additionally, the slider member 13 of the base unit 4d is inserted into the dovetail groove 14a of the guide rail 14 of the fixed unit 3, when the fixed unit 3 is connected to the base unit 4d of the scope unit 2. Furthermore, the slider member 13 slides along the dovetail groove 14a of the guide rail 14 to guide the movement of the base unit 4d. It is to be noted that when a gap between the dovetail groove 14a and the slider member 13 is large, connectors cannot be positioned as will be described later, and therefore the groove and member need to be formed to be fitted into each other as closely as possible. However, when the

member is too closely fitted, it becomes difficult to insert the member, and therefore the chamfered portions 16 are formed on the opposite front/rear ends of each slider member 13.

[0034]

Moreover, as shown in FIG. 1, in the detachable portion the scope unit connection surface 3b1 of the fixed unit 3 and the end plate 4d2 of the base unit 4d of the scope unit 2, an optical connector portion 17 for optical connection and an electric connector portion 18 for electric connection are disposed as a mechanical connection interface portion to detachably connect between the base unit 4d of the scope unit 2 and the fixed unit 3 to function as an endoscope.

[0035]

Furthermore, the optical connector portion 17 includes: a light source side optical connector 19 which is a fixed connector relatively firmly attached to the fixed unit 3 with good positional accuracy; and a light guide connector (hereinafter referred to as an LG connector) 20 which is a movable connector attached to the base unit 4d in a slightly movable state with a backlash (play).

[0036]

FIG. 7(A) shows an attached state of the light source side optical connector 19. The light source side optical connector 19 is constituted of a schematically tubular connector block (receiving member) 21 which fits into the LG connector 20, and the base end of the connector block 21 is screwed/fixed in the lamp housing 9a of the light source unit 9.

[0037]

Furthermore, in the tip end of the connector block 21, a metal cap portion 21a having a large diameter is disposed. The metal cap portion 21a is attached to a connector mounting hole 22 formed in the scope unit connection surface 3b1 of the fixed unit 3.

[0038]

Moreover, an LG connector insertion hole 23 into which the LG connector 20 is inserted is formed in the tube of the connector block 21. In the tip end of the LG connector insertion hole 23, a metal cap tapered portion (tapered fitting hole portion) 23a whose inner diameter gradually increases toward the outside is formed so that the LG connector 20 is easily inserted into a mouth of the connector block 21. In the metal cap portion 21a, the metal cap tapered portion 23a includes a step portion 23b which constitutes an abutment surface at the time of insertion of the LG connector 20 into a rear end position.

[0039]

Moreover, FIG. 7(B) shows the attached state of the LG connector 20. In the base unit 4d of the scope unit 2, an LG connector attachment hole 24 is formed in the end plate 4d2 of the unit case 4d1. The LG connector 20 is inserted into the attachment hole 24, and attached by an LG connector support portion 25. The LG connector support portion 25 includes a play portion 26 which permits the backlash between both the connectors during attachment/detachment of the LG connector 20 with respect to the light source side optical connector 19 of

the fixed unit 3.

[0040]

Moreover, an LG connector main body 27 having a substantially shaft shape is disposed in the LG connector 20. A shaft center portion of the LG connector main body 27 is connected to the base end of a light guide 28 extended from the universal cable 4c side.

[0041]

Furthermore, in the tip end of the LG connector main body 27, a tapered portion 27a is disposed so that the main body is easily inserted into the connector block 21 on the fixed unit 3 side. A step portion 27b which is to be disposed opposite to the abutment surface of the step portion 23b of the connector block 21 is disposed halfway in the LG connector main body 27.

[0042]

Moreover, as shown in FIG. 8(B), a large-diameter shaft portion 27c is formed in a root side end of the LG connector main body 27. A D cut portion 27c1 obtained by cutting opposite side surfaces is formed in the rear end of the large-diameter shaft portion 27c.

[0043]

Furthermore, as shown in FIG. 7(B), the LG connector support portion 25 includes a connector receiving member 29, leaf spring member 30, two connector receiving rings, that is, first connector receiving ring 31 and second connector receiving ring 32. Here, a small-diameter cylindrical portion 31a is disposed on the inner peripheral edge of the first connector receiving ring 31. The inner peripheral surface of the small-

diameter cylindrical portion 31a of the first connector receiving ring 31 is fitted into the outer peripheral surface of the LG connector 20.

[0044]

Additionally, a male screw portion is formed in the outer peripheral surface of the small-diameter cylindrical portion 31a of the first connector receiving ring 31. Furthermore, a meshing cylindrical portion 32a including a screw hole portion meshed with the small-diameter cylindrical portion 31a is formed in the inner peripheral edge of the second connector receiving ring 32. An outer diameter of the meshing cylindrical portion 32a is set to be smaller than an inner diameter of the LG connector attachment hole 24.

[0045]

Moreover, the first connector receiving ring 31 and second connector receiving ring 32 are fitted into the opposite surfaces of the end plate 4d2 of the unit case 4d1. These first connector receiving ring 31 and second connector receiving ring 32 mesh with each other by screws disposed on both the components, and are integrated. At this time, the play portion 26 is formed of a space between the meshing cylindrical portion 32a of the second connector receiving ring 32 and the LG connector attachment hole 24. Moreover, the integrated first and second connector receiving rings 31, 32 are attached to the end plate 4d2 of the unit case 4d1, and in this state the rings can freely move in a range of the play portion 26 in a direction crossing at right angles to an axial direction of the LG connector 20. Accordingly, the LG connector 20 can freely move

in the range of the play portion 26 in the direction crossing at right angles to the axial direction of the LG connector 20.

[0046]

Moreover, in the connector receiving member 29, substantially L-shaped leg portions 29b are bent/formed in the opposite ends of a base plate 29a having a substantially flat plate shape. Furthermore, a square hole 29c having a rectangular shape is formed substantially in a middle position of the base plate 29a.

[0047]

Furthermore, the leaf spring member 30 is disposed inside the connector receiving member 29. This leaf spring member 30 includes a square hole through which a shaft portion 27c2 between both the D cut portions 27c1 in the root side end of the LG connector 20 is inserted. Furthermore, the shaft portion 27c2 between both the D cut portions 27c1 of the root side end of the LG connector 20 is inserted through the square hole 29c of the connector receiving member 29.

[0048]

As shown in FIG. 8(A), a dimension of the square hole 29c is set to be slightly larger than the section of the shaft portion 27c2 between both the D cut portions 27c1 in the root side end of the LG connector 20. It is to be noted that the square hole 29c does not limit the movement in the direction crossing at right angles to the axial direction of the LG connector 20 by the backlash of the LG connector 20, that is, in a range of the play portion 26. Furthermore, by a fitted portion of the shaft portion 27c2 between the D cut portions

27c1 on the opposite sides of the large-diameter shaft portion 27c of the LG connector main body 27 into the square hole 29c, a rotary angle of the LG connector 20 is regulated. Therefore, the light guide 28 is prevented from being twisted or broken.

[0049]

Moreover, as shown in FIG. 7(B), the leg portions 29b of the connector receiving member 29 are both fastened with respect to the end plate 4d2 of the unit case 4d1 together with the leaf spring member 30 by fixing screws. At this time, when strength of the connector receiving member 29 is sufficiently increased, and when the LG connector 20 abuts on another component, a limitation is made such that the LG connector 20 can move in an elastic region of the leaf spring member 30. This prevents the LG connector 20 from compressing or breaking the inner components.

[0050]

Furthermore, at the time of the connection of the light source side optical connector 19 of the optical connector portion 17 to the LG connector 20, the LG connector 20 of the scope unit 2 is inserted into the tube of the connector block 21 of the fixed unit 3. At this time, the connector block 21 is attached to the connector mounting hole 22 of the fixed unit 3 with good positional accuracy, and relatively firmly fixed. On the other hand, the LG connector 20 is supported by the LG connector support portion 25 with the backlash (play) in such a manner that the connector can slightly move with respect to the end plate 4d2 of the unit case 4d1 of the scope unit 2. Therefore, the backlash between both the connectors at the time

of attachment/detachment of the LG connector 20 with respect to the light source side optical connector 19 of the fixed unit 3 can be absorbed by free movement within the range of the play portion 26 of the LG connector support portion 25 in the direction crossing at right angles to the axial direction of the LG connector 20. Moreover, the tapered portion 27a of the tip end of the LG connector 20 abuts on the metal cap tapered portion 23a of the connector block 21, and is guided along the metal cap tapered portion 23a, and in this state the LG connector 20 is inserted into the LG connector insertion hole 23. This forms axial alignment means for carrying out axial alignment between the light source side optical connector 19 and LG connector 20 of the fixed unit 3 at the time of the connection.

[0051]

Moreover, when the LG connector 20 is fitted into the connector block 21, the connector block 21 is positioned in accordance with a lamp (not shown) so that an optical axis of the lamp (not shown) in the light source unit 9 is coaxial with the end surface of the light guide 28 of the LG connector 20. Accordingly, an illuminative light of the lamp (not shown) in the light source unit 9 is converged onto the end surface of the LG connector 20.

[0052]

Furthermore, as shown in FIG. 1, in the electric connector portion 18 between the scope unit connection surface 3b1 of the fixed unit 3 and the end plate 4d2 of the base unit 4d of the scope unit 2, a fixed unit side electric connector (fixed

connector) 33 attached to the fixed unit 3 in a standard position, and a scope side electric connector (movable connector) 34 attached to the base unit 4d are disposed.

[0053]

FIGS. 10(A), 10(B) show the fixed unit side electric connector 33. An electric connector main body 35 of this connector 33 is mounted on a substrate 36. This substrate 36 is connected to one end of a harness 37. The other end of the harness 37 is connected to the system control circuit 10 in the fixed unit 3.

[0054]

Moreover, as shown in FIG. 10(B), connector concave portions 35a for the positioning are disposed in the opposite ends of the electric connector main body 35. Furthermore, as shown in FIG. 10(C), the substrate 36 on which the electric connector 33 is mounted is fixed to the end plate 4d2 of the unit case 4d1 with high positional accuracy.

[0055]

Furthermore, FIGS. 9(A) to 9(C) shows the scope side electric connector 34. An electric connector main body 38 of the scope side electric connector 34 is mounted on a substrate 39. This substrate 39 is connected to one end of a harness 40. The other end of the harness 40 is connected to the angle and CCD control circuit 6 in the scope unit 2.

[0056]

Additionally, as shown in FIG. 9(A), connector convex portions 38a for the positioning are disposed on the opposite ends of the electric connector main body 38. These connector

convex portions 38a are disposed in positions disposed opposite to two connector concave portions 35a of the fixed unit side electric connector 33.

[0057]

Moreover, as shown in FIG. 9(C), the substrate 39 on which the electric connector 34 is mounted is fixed to the end plate 4d2 of the unit case 4d1 via two substantially annular spacer rings, that is, a first spacer ring 42 and second spacer ring 43. Here, a small-diameter cylindrical portion 42a is disposed on the inner peripheral edge of the first spacer ring 42. The inner peripheral surface of the small-diameter cylindrical portion 42a of the first spacer ring 42 is fitted with the outer peripheral surface of a support shaft 42b of the substrate 39. The outer diameter of the support shaft 42b is set to be smaller than the inner diameter of a substrate attachment hole 44 formed in the substrate 39. Moreover, the substrate 39 can freely move in the range of the gap between the support shaft 42b of the substrate 39 and the substrate attachment hole 44 in the direction crossing at right angles to the axial direction of the support shaft 42b. This forms the play portion which permits the backlash between both the connectors at the time of the attachment/detachment of the fixed unit side electric connector 33 with respect to the scope side electric connector 34. It is to be noted that the substrate 39 may also be urged by a spring member 41 so as to prevent the substrate 39 from rattling because of vibration as shown in FIG. 9(B).

[0058]

Furthermore, when the connector convex portions 38a on the

opposite ends of the electric connector main body 38 are fitted into two connector concave portions 35a of the fixed unit side electric connector 33 at the time of the connection of the connector 33 of the electric connector portion 18 with respect to the scope side electric connector 34, the axial alignment is carried out to determine the positions of the connector convex portions 38a of the opposite ends of the electric connector main body 38 in accordance with those of the connector concave portions 35a.

[0059]

Additionally, when the substrate 39 of the scope side electric connector 34 moves in the range of the gap between the support shaft 42b of the substrate 39 and the substrate attachment hole 44 at the time of the connection of the fixed unit side electric connector 33 with respect to the scope side electric connector 34, the connector convex portions 38a of the electric connector main body 38 are inserted and smoothly coupled into the connector concave portions 35a of the electric connector main body 35.

[0060]

Moreover, as shown in FIG. 3, a guide pin 45 and lock member 46 are disposed on the upper end of the end plate 4d2 of the base unit 4d of the scope unit 2. Furthermore, the guide pin 45 and lock member 46 are similarly disposed on the lower end of the end plate 4d2 of the base unit 4d.

[0061]

As shown in FIG. 13, a flange portion 45c is formed on the base end of the shaft member of the guide pin 45. This guide

pin 45 passes through the back surface of the end plate 4d2 of the unit case 4d1, and is fixed by a nut 45b. Accordingly, high positional accuracy is obtained with simple assembling. At this time, the guide pin 45 is attached to the end plate 4d2 of the unit case 41 with the high positional accuracy. Furthermore, a tapered portion 45a is formed in the tip end of the shaft member of the guide pin 45 to facilitate the fitting.

[0062]

Moreover, as shown in FIG. 13, a guide pin receiving member 47 is attached with the high positional accuracy to the scope unit connection surface 3b1 of the fixed unit 3 in a position disposed opposite to the guide pin 45 of the base unit 4d. A pin insertion hole 101a into which the guide pin 45 is to be inserted is formed in a main body 101 of the guide pin receiving member 47. A tapered surface 101b is formed on the mouth of the pin insertion hole 101a so as to facilitate the fitting.

[0063]

Furthermore, FIG. 11(A) shows the lock member 46 which is connection holding means for fastening/fixing the fixed unit 3 and the base unit 4d of the scope unit 2 at the time of the connection of housings. This lock member 46 includes a shaft 49 extended through the base unit 4d on the opposite sides of shaft insertion holes 50. A knob 51 disposed outside the base unit 4d is disposed in the base end of the shaft 49. Furthermore, a substantially spiral lock groove 52 is formed in the tip end of the shaft 49. It is to be noted that an E ring attachment groove is formed in the middle of the shaft 49, and an E ring 49a disposed in the E ring attachment groove prevents the scope

unit 2 from coming off the shaft 49.

[0064]

Additionally, a lock hole 48 is formed in a position opposite to the lock member 46 of the scope unit 2 in a housing panel in the scope unit connection surface 3b1 of the fixed unit 3. A spring member 53 for locking the lock member 46 is fixed to the back surface of the scope unit connection surface 3b1 around the lock hole 48. A linear engaging portion 53a is formed in the spring member 53. The engaging portion 53a engages with the lock groove 52 in the tip end of the shaft 49 of the lock member 46 so as to be engageable/disengageable.

[0065]

Next, a function of the above-described constitution will be described. At the time of the use of the endoscope apparatus 1 of the present embodiment, the base unit 4d of the scope unit 2 is detachably connected to the scope unit connection portion 3b of the unit case 3a of the fixed unit 3. At the time of the connection operation of the base unit 4d, the slider members 13 of the scope unit 2 are inserted into the guide rails 14 of the fixed unit 3. In this state, when the scope unit 2 is slid along the guide rails 14 on the fixed unit 3 side, first the LG connector 20 abuts on the connector block 21 of the fixed unit 3.

[0066]

At this time, the LG connector 20 slightly moves in the direction (X-Y direction) crossing at right angles to the axial direction. When the scope unit 2 is pushed in, the LG connector 20 enters the connector block 21.

[0067]

The tip-end surface of the LG connector 20 reaches a predetermined position in which the light of the lamp of the light source unit 9 in the fixed unit 3 is converged. Then, the step portion 23b disposed as the abutment surface halfway in the connector block 21 abuts on the step portion 27b disposed as the abutment surface halfway in the LG connector 20.

[0068]

When the LG connector 20 is further pushed in from this position, the LG connector 20 urged by the leaf spring member 30 is unchanged, and the leaf spring member 30 is elastically deformed into a sunk state. Therefore, when one fixed unit 3 is selectively combined with a plurality of types of scope units 2, the position of the end surface of the LG connector 20 is constantly maintained in the same position even with scatterings among the plurality of individual types of scope units 2.

[0069]

Furthermore, during the connection operation of the LG connector 20 with respect to the connector block 21, the main body 101 of the guide pin receiving member 47 abuts on the shaft member of the guide pin 45 on the scope unit 2 side with an operation of pushing the base unit 4d of the scope unit 2 toward the fixed unit 3. At this time, when the tapered surface 101b of the guide pin receiving member 47 abuts on the tapered portion 45a of the guide pin 45, the tip end of the guide pin 45 is smoothly inserted and fitted into the pin insertion hole 101a. This determines a positional relation between the fixed unit 3 and the base unit 4d of the scope unit 2 in the axial

direction (Z direction) and the direction (X-Y direction) crossing at right angles to the axial direction.

[0070]

Subsequently, the fixed unit side electric connector 33 of the connector portion 18 is connected to the scope side electric connector 34. At the time of the connection of the electric connector portion 18, first the connector concave portions 35a of the fixed unit side electric connector 33 are allowed to abut on the connector convex portions 38a of the scope side electric connector 34.

[0071]

At this time, the scope side electric connector 34 slightly moves in the direction (X-Y direction) crossing at right angles to the axial direction by the concave/convex portion, and the connector convex portions 38a of the electric connector main body 38 are inserted into two connector concave portions 35a of the fixed unit side electric connector 33. In this state, when the scope unit 2 is further pushed in, the fixed unit side electric connector 33 fits with the scope side electric connector 34, and mutual contact points contact with each other so as to be conductive. The fixed unit side electric connector 33 integrally connected to the scope side electric connector 34 does not move even when vibration is applied, and secure conduction is secured.

[0072]

Thereafter, the lock member 46 is used. At the time of the use of the lock member 46, the base unit 4d of the scope unit 2 is allowed to abut on the scope unit connection surface 3b1 of

the fixed unit 3, and the shaft 49 is pushed while manually rotating the knob 51. At this time, the engaging portion 53a of the spring member 53 on the back surface of the housing panel of the scope unit connection surface 3b1 is fitted into the lock groove 52 in the tip end of the shaft 49.

[0073]

When the shaft 49 is further rotated in this state, the engaging portion 53a of the spring member 53 is pulled in by the lock groove 52 of the shaft 49, and securely locked by a last portion of the lock groove 52. At this time, since the shaft 49 is constantly urged by a spring force of the spring member 53, the shaft is rotated in reverse, and the lock member 46 is not disengaged until the lock is released.

[0074]

Therefore, the above-described constitution produces the following effect. That is, in the industrial endoscope apparatus 1 of the present embodiment, the optical connector portion 17 includes the light source side optical connector 19 which is the fixed connector relatively firmly attached to the fixed unit 3 with the good positional accuracy, and the LG connector 20 which is the movable connector attached in the state with the backlash (play) such that the connector can slightly move with respect to the base unit 4d. Therefore, at the time of the connection of the light source side optical connector 19 which is the fixed connector with respect to the LG connector 20 which is the movable connector, the backlash between both the connectors at the time of the attachment/ detachment of the LG connector 20 with respect to the light

source side optical connector 19 can be permitted by the play portion 26 of the LG connector 20.

[0075]

Furthermore, the tapered portion 27a of the tip end of the LG connector 20 abuts on the metal cap tapered portion 23a of the connector block 21, and is guided along the metal cap tapered portion 23a. When the LG connector 20 is inserted into the LG connector insertion hole 23 in this state, it is possible to carry out the axial alignment between the light source side optical connector 19 which is the fixed connector and the LG connector 20 which is the movable connector.

[0076]

Therefore, even when the position of the connector slightly fluctuates by the fluctuation of the assembling of the plurality of types of scope units 2, the light source side optical connector 19 can be connected to the LG connector 20 which is the movable connector without any problem. As a result, the plurality of types of scope units 2 can be changed so as to be detachable with respect to the fixed unit 3.

[0077]

Furthermore, any loss of an illuminative light amount is not caused in the connected portion of the light source side optical connector 19 to the LG connector 20 which is the movable connector, and original capabilities of a machine can be fulfilled. Similarly, any contact defect of the electric contact is not caused even in the electric connector portion 18 for the electric connection, and the original capabilities of the machine can be fulfilled. Even when the vibration or impact

is applied to the connected portion of the light source side optical connector 19 to the LG connector 20 which is the movable connector, the capabilities can be maintained.

[0078]

It is to be noted that in the present embodiment the constitution including the light source side optical connector 19 disposed as the fixed connector in the fixed unit 3, and the LG connector 20 disposed as the movable connector in the base unit 4d of the scope unit 2 has been described. However, the light source side optical connector 19 of the fixed unit 3 may be replaced with the movable connector, and the LG connector 20 of the base unit 4d of the scope unit 2 may also be replaced with the fixed connector.

[0079]

Moreover, in the present embodiment, when the base unit 4d of the scope unit 2 is attached to the fixed unit 3, the slider member 13 on the scope unit 2 side is aligned with the dovetail groove 14a of the guide rail 14 on the fixed unit 3 side, and is transversely slid, so that the connector can easily be connected.

[0080]

Furthermore, even when the base unit 4d of the scope unit 2 is detached from the fixed unit 3, a sliding direction is determined. Therefore, there is no possibility that an impossible force is applied to break the optical connector portion 17 and connector portion 18 between the base unit 4d of the scope unit 2 and the fixed unit 3. Therefore, it is easy to attach/detach the scope unit 2 with respect to the fixed unit 3.

[0081]

Additionally, there is an effect that the housings of the fixed unit 3 and the base unit 4d of the scope unit 2 can securely be fixed to each other so as to be relatively immobile by the guide pin 45 constituted as described above. Furthermore, even when the vibration or impact is applied to the fixed unit 3 and the base unit 4d of the scope unit 2, any force is not applied to the optical connector portion 17 or the electric connector portion 18, and therefore the optical connector portion 17 can securely be connected to the electric connector portion 18 without being broken.

[0082]

Furthermore, connection defect can be prevented. When the whole surface is used as the abutment surface, the position is influenced by distortion of the surface, and the like. Therefore, when the tapered surface 101b of the guide pin receiving member 47 abuts on the tapered portion 45a of the guide pin 45, the guide pin 45 is positioned not only in the direction (X-Y direction) crossing at right angles to the axial direction but also in the axial direction (Z direction) of the guide pin 45. Furthermore, there is also an effect that structure is simple.

[0083]

Moreover, the locking and the releasing is possible by the lock member 46 constituted as described above with the simple operation. Furthermore, the lock member is urged by the spring force of the spring member 53 at the time of the locking, and therefore there is an effect that the lock of the lock member 46

is not loosened or the connection defect is not easily caused by the vibration or impact. As a result, the housings of the fixed unit 3 and the base unit 4d of the scope unit 2 can securely be fixed to each other with the simple operation at the time of the connection, and the fixed unit 3 and the base unit 4d of the scope unit 2 can securely be fixed against the vibration or impact.

[0084]

Moreover, FIG. 12 shows a bend stop portion 59 of the universal cable 4c disposed in the connected portion of the unit case 4d1 of the base unit 4d to the universal cable 4c. This bend stop portion 59 includes a closely wound coil 54 attached to the periphery of the universal cable 4c. The closely wound coil 54 is formed by a linear material wound in a coil shape. Moreover, the closely wound coil 54 is not excessively short or long, and has an appropriate deflection property.

[0085]

Furthermore, on the tip end of the closely wound coil 54, a cap 55 is meshed and bonded so as to prevent the insertion portion 4a from being damaged by the coil end. Furthermore, a base member 56 is disposed on the base end of the closely wound coil 54. The base member 56 is fixed to the unit case 4d1 by screws from the back surface. Moreover, the base end of the closely wound coil 54 is meshed with the base member 56, and fixed by immobile screws to be prevented from loosening.

[0086]

Additionally, inside the base member 56, an O-ring 57 is attached so as to prevent a liquid transferred along the

insertion portion 4a from entering the housing of the unit case 4d1. The O-ring 57 is attached in an appropriately compressed state by an O-ring press member.

[0087]

The bend stop portion 59 is contained in a bent state with a small bend radius R so as to be contained in a compact manner at the time of storage of the endoscope apparatus 1. Moreover, at the time of the use of the endoscope apparatus 1, by the spring force of the closely wound coil 54, a large bend radius R, or a straight extended state shown by a solid line in FIG. 12 is obtained.

[0088]

Moreover, when a corrugated tube of the universal cable 4c is pulled at the time of endoscopic inspection, as shown by a virtual line in FIG. 12, the bend stop portion 59 is bent, but returns to its original state, when a tensile force is weakened.

[0089]

Then, the bend stop portion 59 constituted as described above is bent to have an appropriate curvature using the closely wound coil 54, and sufficient curve capabilities can be obtained. This can solve a problem that a conventional bend stop portion molded of a rubber in a tapered shape does not return to the original state once bent or that the corrugated tube buckles or bends in the end of the bend stop portion with a hardened rubber.

[0090]

Moreover, FIG. 14 is an electric system block diagram showing the schematic constitution of the inside of the fixed

unit 3 and the base unit 4d in the scope unit 2 in the industrial endoscope apparatus 1 of the present embodiment.

[0091]

In the base unit 4d of the scope unit 2, power is supplied via the scope side electric connector 34, and the angle and CCD control circuit 6 is disposed to transmit/receive a control signal. The angle and CCD control circuit 6 is connected to a CCD and angle driving circuit of the observation optical system of a scope (not shown) disposed on the tip-end surface of the head portion 4a1 of the insertion portion 4a. Any of a plurality of connector connection detection signal lines 62 is connected to GND of the circuit.

[0092]

The fixed unit 3 includes a power supply circuit 8 which is connected to a commercial power supply or a DC power supply via a power supply cord (not shown) and which is constituted of a main power supply 8a and a standby power supply 8b. The main power supply 8a supplies power to the scope unit 2 via the system control circuit 10 and the connected portion of the fixed unit side electric connector 33 to the scope side electric connector 34. A connector connection detection circuit 61 supplies the power from the standby power supply 8b. For the connector connection detection circuit 61, a connector connection detection signal line 62 of the scope unit 2 is connected to the main power supply 8a which is connected to control output via the scope side electric connector 34 and the fixed unit side electric connector 33. For the system control circuit 10, a signal line of the control signal is connected to

the scope unit 2 via the connected portion of the fixed unit side electric connector 33 and scope side electric connector 34.

[0093]

FIG. 15 shows an arrangement example of the connector connection detection signal lines 62 in the fixed unit side electric connector 33 and scope side electric connector 34. Here, an example is shown in which the connector connection detection signal lines 62 are arranged in diagonal positions of connectors disposed in two columns.

[0094]

Next, the function of the above-described constitution will be described. When the power supply circuit is connected to the commercial power supply or the DC power supply via the power supply cord (not shown), the power is supplied to the connector connection detection circuit 61 from the standby power supply 8b in the power supply circuit 8.

[0095]

Here, when the fixed unit side electric connector 33 is incompletely connected to the scope side electric connector 34, some or all of the connector connection detection signal lines 62 are not connected to the GND with respect to the connector connection detection circuit 61, and the signal line with respect to the main power supply 8a prohibits a power supply output of the main power supply 8a. Since the power supply output of the main power supply 8a is prohibited, the system control circuit 10 and the angle and CCD control circuit 6 do not operate.

[0096]

When the fixed unit side electric connector 33 is completely connected to the scope side electric connector 34, all of the connector connection detection signal lines 62 are connected to the GND with respect to the connector connection detection circuit 61, and therefore the signal line with respect to the main power supply 8a permits the power supply output of the main power supply 8a. Since the power supply output of the main power supply 8a is permitted, the system control circuit 10 and the angle and CCD control circuit 6 operate.

[0097]

Furthermore, an angle of the scope unit 2 is controlled based on the control of the system control circuit 10, and the CCD on the endoscope tip end is directed in a target direction. The CCD outputs a video signal based on a driving signal of the CCD control circuit 6, and transmits the signal to the angle and CCD control circuit 6. At this time, in the angle and CCD control circuit 6, a signal by which CRT display is possible is input to the system control circuit 10 via the connectors 33 and 34. The system control circuit 10 outputs the signal to a display CRT or a display LCD (not shown) so that the signal is formed into an image.

[0098]

Moreover, as shown in FIG. 16, a plurality of types of optical adapters 100 are selectively and detachably attached to the head portion 4a1 of the endoscope apparatus 1 of the present embodiment. In the optical adapters 100, for example, in addition to a direct-sight adapter 100a1 and a side-sight

adapter 100a2, a direct-sight binocular adapter 100a3 for stereo measurement, and a side-sight binocular adapter 100a4 are disposed. It is to be noted that FIG. 17 is a longitudinal sectional view of the direct-sight binocular adapter 100a3 for the stereo measurement, and FIG. 18 is a longitudinal sectional view of the side-sight binocular adapter 100a4.

[0099]

Each of these optical adapters 100 includes an adapter opening 103, an adapter illuminating window 105, and an observation window 107 of an adapter observation optical system. Moreover, in a state in which the optical adapters 100 is attached to the head portion 4a1 of the endoscope apparatus 1, the tip-end side opening 101, illuminating window 104, and observation window 106 of the inner channel 102 in the head portion 4a1 of the endoscope apparatus 1 are connected to the adapter opening 103 of the optical adapter 100, the adapter illuminating window 105, and the observation window 107 of the adapter observation optical system, respectively. Accordingly, the illuminative light transmitted from the light source unit 9 via the LG connector 20 is projected onto the surface of an object from the illuminating window 104 of the head portion 4a1 via the adapter illuminating window 105 in the surface of the adapter. Furthermore, the image is similarly formed in the solid image pickup device built in the head portion 4a1 from the observation window 107 of the adapter observation optical system of each adapter 100 via the observation window 106 of the observation optical system of the head portion 4a1.

[0100]

Moreover, in the direct-sight binocular adapter 100a3, and side-sight binocular adapter 100a4, the observation window 107 of the adapter observation optical system includes two adapter observation windows 108 for forming the image onto one solid image pickup device in two optical paths. It is a known fact that the stereo measurement uses parallax at the time of the image formation on the solid image pickup device via the two adapter observation windows 108, and uses principle of triangulation. A constitution, function, and effect of the present invention concerning this measurement will next be described.

[0101]

Furthermore, the system control circuit 10 includes a measurement function of correcting an optical strain of an endoscopic image input from the scope unit 2 to measure a dimension, area, and the like of an observation object. For the scope unit 2, scope information is input, for example, into the angle and CCD control circuit 6. The system control circuit 10 can carry out the measurement with good accuracy based on the scope information.

[0102]

Then, in the above-described constitution, a part of the fixed unit side electric connector 33 and scope side electric connector 34 can be used to detect the connection of the scope unit 2. Moreover, it is judged by the connector connection detection signal circuit 62 whether or not the connection of the fixed unit side electric connector 33 to the scope side electric

connector 34 is secure, and the operation of the main power supply 8a is controlled based on a judgment result. Furthermore, endoscope information is recorded in the changeable scope unit 2, and the measurement is carried out in the system control circuit 10. Accordingly, only when the connection of the fixed unit side electric connector 33 to the scope side electric connector 34 is secure, the system control circuit 10 and angle and CCD control circuit 6 can be operated, and accordingly malfunction and trouble of the circuit can be prevented in advance.

[0103]

Furthermore, when the scope information indicating the type and individual piece of the scope unit 2 is recorded for each scope unit 2, the system control circuit 10 including scope information read means can adjust individual characteristics of the scope unit 2 based on the scope information at the time of execution of the measurement function, and can suppress influences of the type and individual difference of the scope unit 2 to further enhance measurement accuracy.

[0104]

Moreover, in the present embodiment, the scope information for measurement is stored in the angle and CCU control circuit 6 of the scope unit 2. Here, ROM which is scope information storage means is built, for example, in the angle control circuit 6. Furthermore, in CPU of the fixed unit 3, a scope information read unit for reading the scope information, a measurement information storage unit, and a scope information comparison unit are built, respectively.

[0105]

Next, the function of the present embodiment constituted as described above will be described with reference to flowcharts of FIGS. 19 and 20. First, it is judged whether or not measurement information exists in step S1 and step S2. When it is judged in the judgment that the measurement information exists in step S2, the process proceeds to step S5, and the process starts as such. On the other hand, when the measurement information does not exist, a measurement information preparation process starts.

[0106]

In the measurement information preparation process, the scope information is read out in step S3, and the measurement information is prepared in step S4 in accordance with content. The scope information is constituted of a serial number, scope diameter, scope length, and scope manufacturing date. These data are also held as the measurement information.

[0107]

The prepared measurement information is recorded in the measurement information storage unit, and the content is held, even when the power is cut off. Furthermore, the measurement information is read in step S12 at the time of measurement start in step S11, and used as a parameter of the measurement. Furthermore, at this time the scope information is also read in step S13, and the scope information comparison unit compares the information with the content of the measurement information to judge whether or not there is any discrepancy in step S14. When it is judged in step S15 that there is not any discrepancy, the

process proceeds to step S16 to start measurement process.

[0108]

On the other hand, when there is the discrepancy in step S15, it is judged that the scope unit 2 different from that at the time of the measurement information preparation is connected. In this case, a caution is given in step S17, and the measurement process is stopped in the subsequent step S18.

[0109]

Then, in the present embodiment constituted as described above, a change of the scope unit 2 is detected, the measurement process is not carried out with respect to the image photographed by the scope unit 2 different from that at the time of the measurement information preparation, and accordingly inaccurate measurement is prevented.

[0110]

It is to be noted that the endoscope apparatus 1 of the present embodiment includes three-dimensional glasses 109 such as a face mount display for combined use with the direct-sight binocular adapter 100a3 or side-sight binocular adapter 100a4 as shown in FIG. 21. The glasses may also be used instead of the monitor 12 or may accessorily be used or may also be connected to a video output connector 110 of the monitor 12 or a remote controller video output connector 111 disposed in the operation remote controller 11.

[0111]

In this case, the parallax of the direct-sight binocular adapter 100a3 or the side-sight binocular adapter 100a4 can be used to visually recognize a three-dimensionally displayed

image, the surface of the object or the state of the position is faithfully understood, and there are effects that position visibility is enhanced and inspection efficiency increases. Furthermore, when the optical adapters 100 such as the direct-sight binocular adapter 100a3 are attached to the tip end of the head portion 4a1 as shown in FIG. 22, the position visibility of forceps 104 extended from the adapter opening 103 is also enhanced, and there is an effect that operability of the forceps 104 is enhanced.

[0112]

In the present embodiment, the measurement information preparation process is executed by the endoscope apparatus 1. However, even in a constitution in which the process is executed in external processing apparatuses such as PC and the prepared measurement information is recorded in the measurement information storage unit, it is clear that the constitution is equivalent to the present embodiment.

[0113]

Moreover, FIGS. 23(A) and 23(B) show a second embodiment of the present invention. In the present embodiment, the constitution of the scope unit 2 of the endoscope apparatus 1 of the first embodiment (see FIGS. 1 to 22) is changed as follows. It is to be noted that a basic constitution of the endoscope apparatus 1 of the present embodiment is substantially similar to that of the first embodiment. Therefore, the same parts as those of the first embodiment are denoted with the same reference numerals, and the description thereof is omitted.

[0114]

That is, as shown in FIG. 23(B), a solid image pickup device 82 of an observation optical system 81 is disposed substantially in a middle portion on the tip-end surface of the head portion 4a1 of the scope unit 2 of the present embodiment. The solid image pickup device 82 is connected to a camera control unit 53 via a signal line 83.

[0115]

Furthermore, light emitting diodes (LED) 85 forming an illuminating unit 84 are disposed on the opposite sides of the solid image pickup device 82. Each LED 85 is disposed on a control circuit substrate 86. The control circuit substrate 86 is connected to a power supply unit 7 via a power supply cord 87. Moreover, the power is supplied to each LED 85 from the power supply unit 7 via the power supply cord 87 to emit the light.

[0116]

Then, the above-described constitution produces the following effects. That is, in the endoscope apparatus 1 of the present embodiment, the LED 85 is disposed on the tip-end surface of the head portion 4a1 of the scope unit 2, this LED 85 is used as the light source of the illuminative light, and therefore the light source unit 9 which has been required in the first embodiment is unnecessary. Therefore, the fixed unit 3 which is an external apparatus separate from the scope unit 2 can further be miniaturized/lightened, and an attachment/detachment mechanism of the base unit 4d of the scope unit 2 to the fixed unit 3 can be simplified.

[0117]

Moreover, FIG. 24 shows a third embodiment of the present invention. In the present embodiment, the constitutions of the fixed unit side electric connector 33 and scope side electric connector 34 of the endoscope apparatus 1 of the first embodiment (see FIGS. 1 to 22) are changed as follows. It is to be noted that the basic constitution of the endoscope apparatus 1 of the present embodiment is substantially similar to that of the first embodiment. Therefore, the same parts as those of the first embodiment are denoted with the same reference numerals, and the description thereof is omitted.

[0118]

That is, a fixed unit side electric connector 91 is directly attached to the scope unit connection surface 3b1 of the fixed unit 3 in the present embodiment. Here, a connector mounting hole 93 is formed in the scope unit connection surface 3b1 of the fixed unit 3. A main body 94 of the fixed unit side electric connector 91 is disposed in the connector mounting hole 93.

[0119]

Connector concave portions 94a for the positioning are disposed in the opposite ends of the electric connector main body 94. Furthermore, protrusions 94b for attachment are disposed on the opposite sides of the connector main body 94. A screw insertion hole 94c is formed in each protrusion 94b. Moreover, the protrusion 94b of the electric connector main body 94 is fixed to the scope unit connection surface 3b1 of the fixed unit 3 by a fixing screw 95 with the high positional

accuracy.

[0120]

Moreover, one end of a harness 94d is connected to the connector main body 94 of the fixed unit 3. The other end of the harness 94d is connected to the system control circuit 10 in the fixed unit 3.

[0121]

Furthermore, a scope side electric connector 92 is directly attached to the end plate 4d2 of the unit case 4d1 of the scope unit 2. Here, a connector mounting hole is formed in the end plate 4d2 of the unit case 4d1. A main body 96 of the scope unit side electric connector 92 is disposed in this connector mounting hole.

[0122]

Connector convex portions 96a for the positioning are disposed on the opposite ends of the connector main body 96. Furthermore, protrusions 96b for attachment are disposed on the opposite sides of the connector main body 96. A screw hole 98 having a diameter larger than that of a screw portion of a fixing screw 97 is formed in each protrusion 96b. The electric connector main body 96 is attached to the end plate 4d2 of the unit case 4d1 by the fixing screw 97 inserted in the large-diameter hole 98 of the protrusion 96b.

[0123]

Moreover, the electric connector main body 96 is connected to one end of a harness 96d. The other end of this harness 96d is connected to the angle and CCD control circuit 6 in the scope unit 2.

[0124]

Furthermore, when the connector convex portions 96a of the opposite ends of the electric connector main body 96 are fitted into two connector concave portions 94a of the fixed unit side electric connector 91, respectively, at the time of the connection of the fixed unit side electric connector 91 to the scope side electric connector 92, the axial alignment is carried out so that the positions of the connector convex portions 96a of the opposite ends of the electric main body 96 are determined in accordance with those of the connector concave portions 94a.

[0125]

Furthermore, at the time of the connection of the fixed unit side electric connector 91 to the scope side electric connector 92, the electric connector main body 96 moves in the range of the gap between a large-diameter hole 98 of the protrusion 96b and the fixing screw 97, and accordingly the connector convex portions 96a of the electric connector main body 96 are inserted into and are smoothly coupled to the connector concave portions 94a of the connector main body 94.

[0126]

Then, in the first embodiment of the present invention, the substrate 36 of the fixed unit side electric connector 33 of the first embodiment, and the substrate 39 of the scope side electric connector 34 are not required, and therefore there is an effect that the constitution can be simplified.

[0127]

It is to be noted that the present invention is not limited to the above-described embodiments. For example, the connecting

portion of the fixed unit 3 to the base unit 2 is not limited to the optical connector for the illuminative light or the electric connector for the signal. For example, a connector for a fluid may also be used, and the connecting portion is not limited as long as the base unit 4d of the scope unit 2 is detachably connected to the fixed unit 3 and the connecting portion is required for substantially functioning as the endoscope apparatus and is mechanical.

[0128]

Furthermore, needless to say, the present invention can additionally variously be modified/carried out without departing from the scope.

Now, other characteristic technical matters of the present invention will be appended below.

Appendices

(Appendix 1)

There is provided an endoscope apparatus which comprises: a main housing to which an operation remote controller to operate the apparatus and a monitor to perform display are connected, and which includes a power supply unit, a light source unit, a lamp lighting circuit and a circuit relay substrate; and a scope unit (insertion portion housing) which includes an elongate insertion portion, a solid image pickup device disposed in a tip end of the insertion portion, a control circuit for the image pickup device, a curve control mechanism, a curve control circuit and a circuit relay substrate, a plurality of scope units being attached/detached with respect to the main housing, the apparatus characterized by comprising: guide means for

connecting the both housings by sliding; positioning means for preventing relative positions of the both housings from being misaligned; and fixing means for maintaining the above state, in which a connection interface portion allowing the housings to function as an endoscope (a mechanically connecting portion which is required for substantially functioning as the endoscope through connection of the both housings, not limited to the connector for the illuminative light or the connector for the signal) can be connected and is attached to one of the housings with a good positional accuracy (fixed firmly), and attached to the other housing in a slightly movable state with a backlash (play).

[0129]

(Appendix 2)

There is provided an endoscope apparatus according to Appendix 1, characterized by comprising the main housing and the scope unit, and with respect to a connector for connecting an illuminative light and a connector for connecting a power supply or electric signals, in which one of the relative connectors is attached with a good positional accuracy (fixed), and the other connector is attached in a slightly movable state with a backlash (play), the backlash of the connector allows the axes of the both connectors to be fitted with each other at the time of connection, and positioning members provided in the both housings to prevent misalignment of the relative positions of the housings are fitted with each other at the time of the connection.

[0130]

(Appendix 3)

There is provided an endoscope apparatus according to Appendix 2, characterized in that in the connected portion of a light guide, a tapered portion is provided in a metal cap portion of a connector connection member provided in the main housing, and in the connecting portion of a light guide of the scope unit, an LG connector to which the light guide is attached is provided, and a hole is provided in a housing panel to insert the LG connector therethrough, the diameter of the hole provided in the panel being larger than the outer diameter of the LG connector (backlash) in a range of the gap where the LG connector arbitrarily moves in the X-Y directions (axial direction and vertical direction).

[0131]

(Appendix 4)

There is provided an endoscope apparatus according to Appendix 3, characterized in that the scale of the backlash provided in the connecting portion of the light guide is within the range of being pulled in by the tapered portion provided in the metal cap portion of the connector connection member in the main housing even if the position of the LG connector is misaligned because of the fluctuation of assembly.

[0132]

(Appendix 5)

There is provided an endoscope apparatus according to Appendix 2, characterized in that, in a connector portion provided with electric contact point for connecting a power

supply and an electric signal, a substrate on which a connector is mounted is attached to the main housing, and a substrate on which a connector relative to the scope unit is mounted is attached to an housing panel via a substrate attachment member, the diameter of an attachment hole provided in the substrate being larger than the outer diameter of the substrate attachment member (backlash) in a range of the gap where the substrate arbitrarily moves in the X-Y directions (axial direction and vertical direction). (Presence/absence of the substrate is not affected. The connector itself can directly be attached to the housing.)

(Appendix 6)

The scale of the backlash in a connector portion provided with electric contact point for connecting a power supply and an electric signal is within the range of being pulled in by a connector provided in the main housing even if the position of the connector is misaligned because of the fluctuation of assembly.

[0133]

(Appendix 7)

There is provided an endoscope apparatus according to Appendix 2, characterized in that a receiving member having a taper at its mouth is provided in the main housing to smoothly insert a counterpart member so that a relative positional misalignment of the both housings can be prevented when the main housing and the scope unit are connected to each other, and a protrusion is provided in the scope unit to fit into the counter receiving member.

[0134]

(Appendix 8)

There is provided an endoscope apparatus which is composed of: a main housing having a light source unit and a control circuit; and a scope unit having a curve mechanism and a control circuit, a plurality of scope units being attached/detached by a connector which carries out connection of a light guide (illuminative light) and connection of a light source and electric signal, the apparatus characterized in that

one of the relative connectors is attached with a good positional accuracy, and the other connector is attached in a slightly movable state with a backlash, the backlash of the connector allows the axes of the both connectors to be fitted with each other at the time of the connection, and positioning members provided in the both housings are fitted with each other at the time of the connection.

[0135]

(Appendix 9)

The endoscope apparatus in which scope information for measurement is stored in a scope unit control circuit.

[0136]

(Appendix 10)

The endoscope apparatus which carries out connection detection of the scope unit using some of EL connector pins.

[0137]

(Appendix 11)

There is provided an endoscope apparatus characterized in that a coiled wire rod with a corrugated tube inserted therein

is provided at a base portion where the corrugated tube extends out of the endoscope main body.

[0138]

(Prior art relating to Appendices 1 through 8)

There is provided an endoscope apparatus which is used in combination with a plurality of types of scope units which are different from the main housing.

[0139]

(Objects to achieve Appendices 1 through 8)

When the position of a connector does not agree with that of the socket because of fluctuation by assembly during manufacturing, the scope unit cannot be attached/detached. Furthermore, when the scope units cannot securely be positioned, loss of an illuminative light amount, or contact defect of an electric contact is caused, and original capabilities possessed by machines cannot be fulfilled. Breakage is caused in a connected portion by vibration or impact.

[0140]

(Object of Appendices 1 through 8)

To provide a system that can exhibit a sufficient performance through the compatibility and secure connection in an endoscope apparatus used in combination with a plurality of types of scope units which are different from the main housing.

[0141]

(Advantages of Appendices 1 through 8)

Even if the position of the connector somewhat fluctuates because of the fluctuation of assembly, the connection can be carried out without any problem. The scope unit can securely

and easily be attached and detached. Loss of an illuminative light amount, or contact defect of an electric contact is not caused, and original capabilities possessed by machines can be fulfilled. Even if vibration or impact is applied, the capabilities can be maintained.

[0142]

(Prior art relating to Appendix 11)

A conventional bend stop portion molded of a rubber in a tapered shape.

[0143]

(Object to achieve Appendix 11)

The conventional bend stop portion molded of a rubber in a tapered shape does not return to the original state once bent. In addition, the corrugated tube buckles or bends in the end of the bend stop portion with a hardened rubber. If the corrugated tube bends sharply at the portion where the endoscope (corrugated tube) extends out of the housing, sufficient curve capabilities cannot be obtained. Further, the curvature increases friction between the coil pipe and angle wire, affecting the durability of the wire.

[0144]

(Object of Appendix 11)

To provide a bend stop which is contained in a bent state with a small bend radius R in a compact manner at the time of storage of the endoscope apparatus, and with a large bend radius R at the time of being pulled out for use, with exhibition of sufficient curve capabilities. The corrugated tube bends with a smooth curvature without a sharp bend.

[0145]

(Advantage of Appendix 11)

The conventional bend stop portion molded of a rubber in a tapered shape does not return to the original state once bent. In addition, the corrugated tube buckles or bends in the end of the bend stop portion with a hardened rubber. By obtaining a closely wound coil, the corrugated tube bends with an appropriate curvature. Therefore, sufficient curve capabilities can be obtained.

[0146]

[Advantages of the Invention]

According to the invention of claim 1, a fixed connector is provided in a standard position in at least one of a connector on the side of the scope unit and a connector on the side of the fixed unit in a connector portion disposed in a detachable portion of the base unit and the fixed unit, and a movable connector is provided in the other one of the connector on the side of the scope unit and the connector on the side of the fixed unit, the movable connector having a play portion for permitting the backlash between both the connectors at the time of the attachment/detachment with respect to the fixed connector, and axial alignment means is provided to carry out axial alignment between the fixed connector and the movable connector at the time of the connection. Thus, it is possible to provide an endoscope apparatus which can be used by combining a fixed unit used in common with a plurality of types of scope units of external apparatus, thus enabling a sufficient performance to be exhibited through the compatibility and secure

connection.

[0147]

According to the invention of claim 2, when the connector on the fixed unit side is connected to that on the base unit side, the positioning means provided in the detachable portion for the base unit of the scope unit and the fixed unit can determine the connected position of the fixed unit side and the base unit side.

[0148]

According to the invention of claim 3, a tapered fitting hole portion of a receiving member provided in at least one of the base unit and the fixed unit is fitted into by the protrusion of the other, so that the connected position of the fixed unit side and the base unit side is determined.

[0149]

According to the invention of claim 4, the axial alignment means provided in at least one of the optical connector portion and the electric connector portion carries out axial alignment between the fixed connector and the movable connector.

[0150]

According to the invention of claim 5, the axial alignment means provided in the electric connector portion for electric connection carries out axial alignment between the fixed connector and the movable connector.

[0151]

According to the invention of claim 6, the connection detection means provided in the electric connector portion carries out connection detection of the scope unit using some of

a plurality of connector pins disposed on the connector main body.

[0152]

According to the invention of claim 7, the base unit of any one of a plurality of types of scope units disposed beforehand is selectively and detachably connected to the fixed unit, the scope information for measurement stored in the first control circuit of the base unit identifies a type and individual piece of the scope unit, and the first control circuit of the base unit and the second control circuit of the fixed unit control measurement function of the endoscope apparatus.

[Brief Description of the Drawings]

[FIG. 1]

A schematic constitution diagram of a whole endoscope apparatus for industrial use according to a first embodiment of the present invention.

[FIG. 2]

A perspective view showing that a base unit of a scope unit is detached from a fixed unit in the endoscope apparatus for industrial use according to the first embodiment.

[FIG. 3]

A perspective view showing a detachable portion of the base unit of the scope unit and the fixed unit in the endoscope apparatus for industrial use according to the first embodiment.

[FIG. 4]

FIG. 4(A) is a side view of the base unit of the scope unit in the endoscope apparatus for industrial use according to the first embodiment, FIG. 4(B) is a front view of the unit, and

FIG. 4(C) is a sectional view along line IVC-IVC of FIG. 4(B).

[FIG. 5]

A rear view of the base unit of the scope unit in the endoscope apparatus for industrial use according to the first embodiment.

[FIG. 6]

FIG. 6(A) is a longitudinal sectional view showing a fitted portion of a guide rail on the side of the fixed unit of the endoscope apparatus for industrial use according to the first embodiment into a slider on the side of the base unit of the scope unit, and FIG. 6(B) is a side view showing a state before the guide rail on the side of the fixed unit is fitted into the slider on the side of the base unit of the scope unit.

[FIG. 7]

FIG. 7(A) is a longitudinal sectional view showing an attached state of a connector block in the fixed unit of the first embodiment, and FIG. 7(B) is a longitudinal sectional view showing the attached state of a light guide connector on the side of the base unit of the scope unit.

[FIG. 8]

FIG. 8(A) is a plan view showing an attached portion of the light guide connector on the side of the base unit of the scope unit of the first embodiment, and FIG. 8(B) is a perspective view showing the light guide connector.

[FIG. 9]

FIG. 9(A) is a plan view showing the electric connector of the base unit in the scope unit of the first embodiment,
FIG. 9(B) is a plan view showing that the electric connector is

attached to an attachment substrate of the electric connector, and FIG. 9(C) is a sectional view along line IXC-IXC of FIG. 9(B).

[FIG. 10]

FIG. 10(A) is a plan view showing the electric connector on the side of the fixed unit in the scope unit of the first embodiment, FIG. 10(B) is a plan view showing that the electric connector is attached to the attachment substrate of the electric connector, and FIG. 10(C) is a longitudinal sectional view of a major part showing a connected state of the electric connector of the base unit in the scope unit with respect to the electric connector on the side of the fixed unit.

[FIG. 11]

FIG. 11(A) is a longitudinal sectional view of a major part showing the attached state of a fixing member of the fixed unit with respect to the base unit in the scope unit of the endoscope apparatus of the first embodiment, FIG. 11(B) is a plan view showing a fixing spring member of the fixed unit, and FIG. 11(C) is a perspective view showing a lock groove of a shaft of the fixing member.

[FIG. 12]

A longitudinal sectional view of a major part showing a bent stop portion of a corrugated tube in the scope unit of the first embodiment.

[FIG. 13]

A longitudinal sectional view showing a connected state of the fixed unit with respect to the base unit in the scope unit of the endoscope apparatus for industrial use according to the

first embodiment.

[FIG. 14]

A schematic constitution diagram showing the inside of the fixed unit and the base unit in the scope unit in the endoscope apparatus for industrial use according to the first embodiment.

[FIG. 15]

A schematic constitution diagram showing a connector detection signal line of the electric connector on the side of the fixed unit in the endoscope apparatus for industrial use according to the first embodiment.

[FIG. 16]

A perspective view showing a plurality of types of optical adapters connected to a tip-end surface of a head portion in the endoscope apparatus for industrial use according to the first embodiment.

[FIG. 17]

A longitudinal sectional view of a direct-sight binocular adapter for stereo measurement in the endoscope apparatus for industrial use according to the first embodiment.

[FIG. 18]

A longitudinal sectional view of a side-sight binocular adapter in the endoscope apparatus for industrial use according to the first embodiment.

[FIG. 19]

A flowchart showing an operation at a connection detection time at which the connection of the scope unit is detected in the endoscope apparatus for industrial use according to the first embodiment.

[FIG. 20]

A flowchart showing a modification example of the operation at the connection detection time at which the connection of the scope unit is detected in the endoscope apparatus for industrial use according to the first embodiment.

[FIG. 21]

A schematic whole constitution diagram showing that three-dimensional glasses are connected to the endoscope apparatus for industrial use according to the first embodiment.

[FIG. 22]

A perspective view showing an extended state of forceps from an adapter opening in a state in which the direct-sight binocular adapter is attached to a tip end of the head portion in the endoscope apparatus for industrial use according to the first embodiment.

[FIG. 23]

Illustration of a second embodiment of the present invention, in which FIG. 23(A) is a perspective view of the scope unit, and FIG. 23(B) is a schematic constitution diagram showing an observation unit in the tip end of an insertion portion.

[FIG. 24]

A longitudinal sectional view showing a modification example of an attaching portion of the electric connector of the base unit in the scope unit and that of the electric connector on the side of the fixed unit in the scope unit.

[Explanation of Reference Symbols]

2: Scope unit

3: Fixed unit

4a: Insertion portion

4a1: Head portion (observation unit)

4a2: Curved portion

4d: Base unit

17: Optical connector portion

19: Light source side optical connector (fixed connector)

20: LG connector (movable connector)

21: Connector block (receiving member)

23a: Metal cap tapered portion (tapered fitting hole portion)

26: Play portion

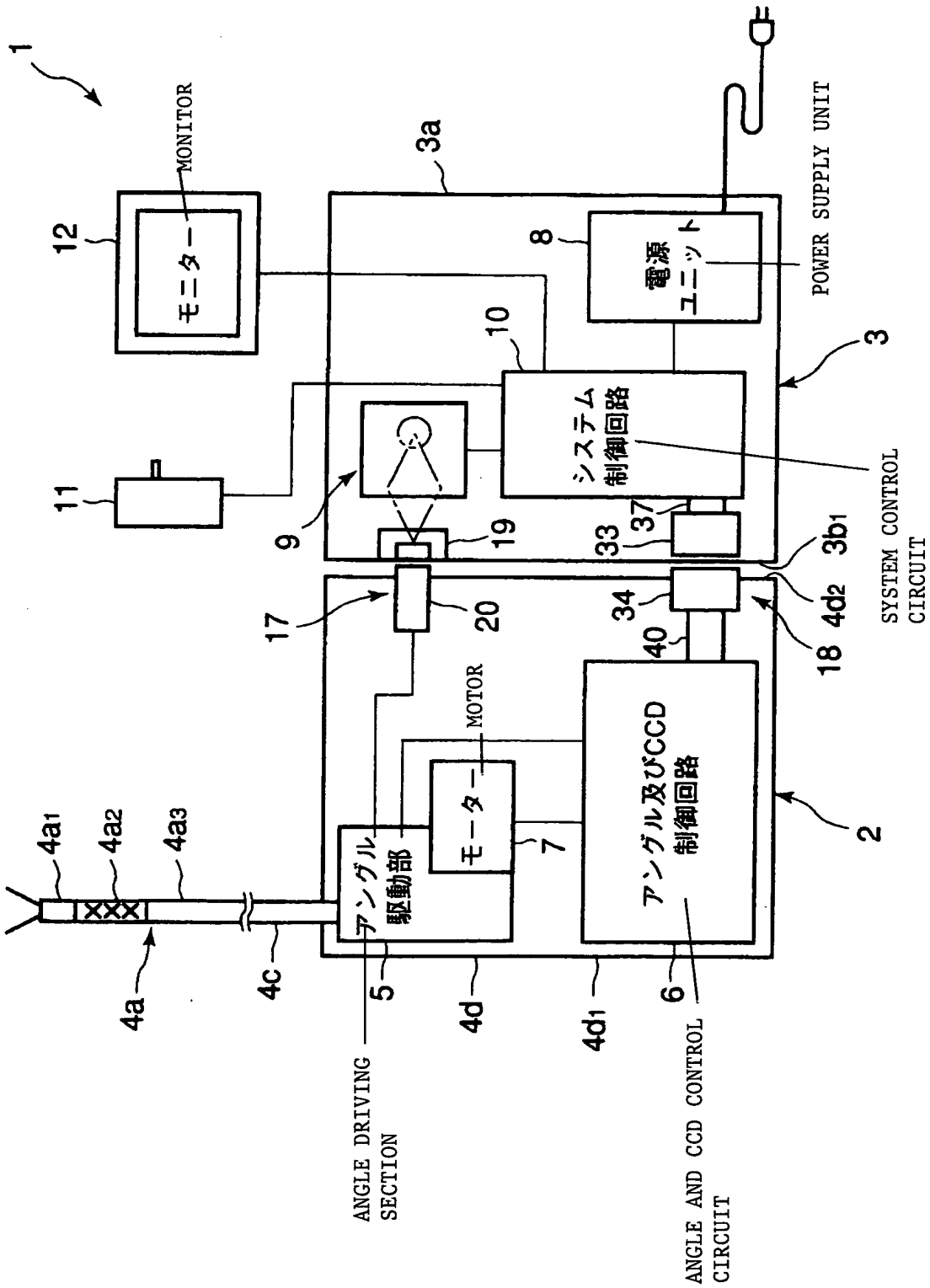
27: LG connector main body

27a: Tapered portion (axial alignment means)

NAME OF DOCUMENT

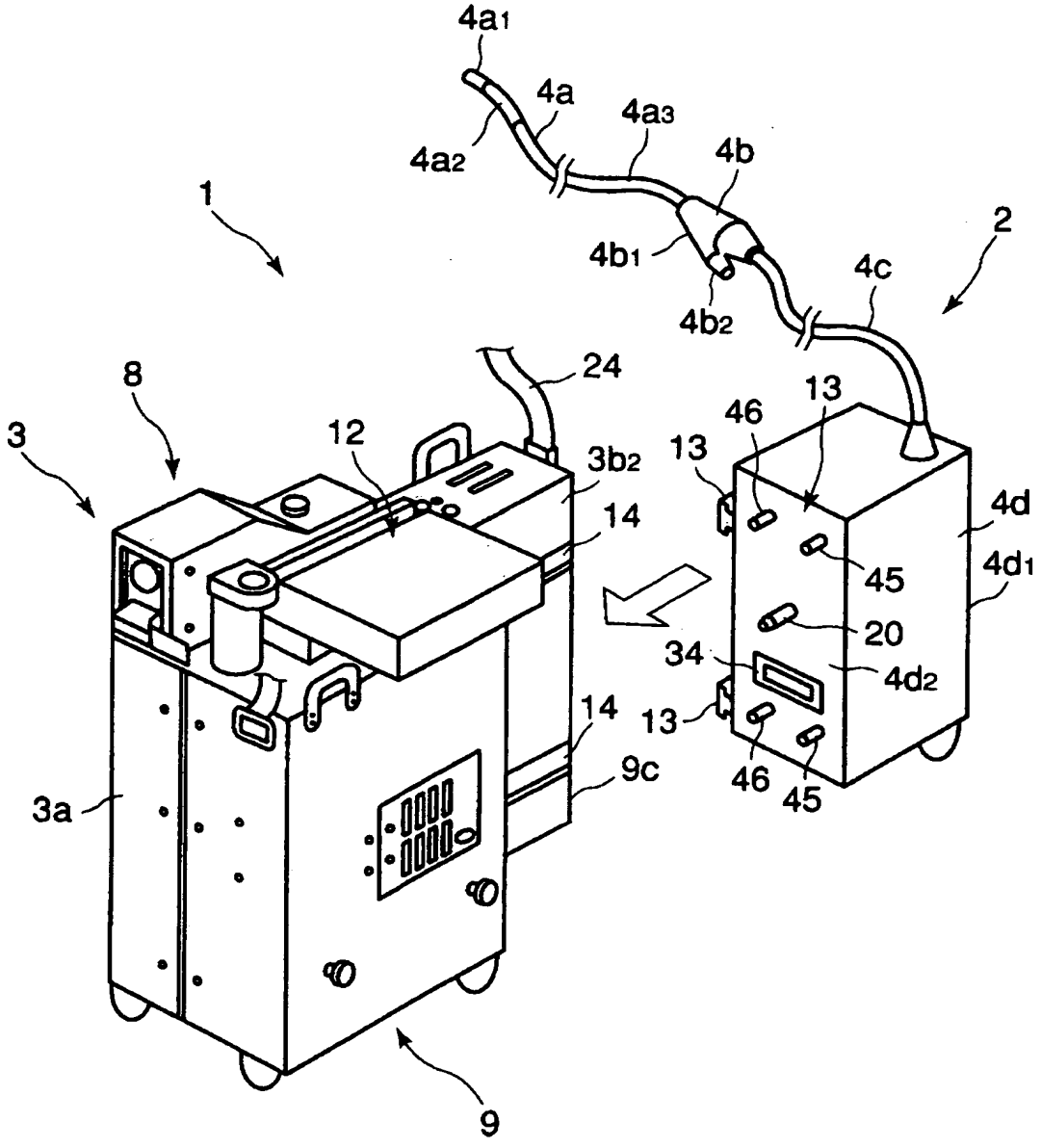
【書類名】 図面 DRAWINGS

【図１】
FIG. 1



【図２】

FIG. 2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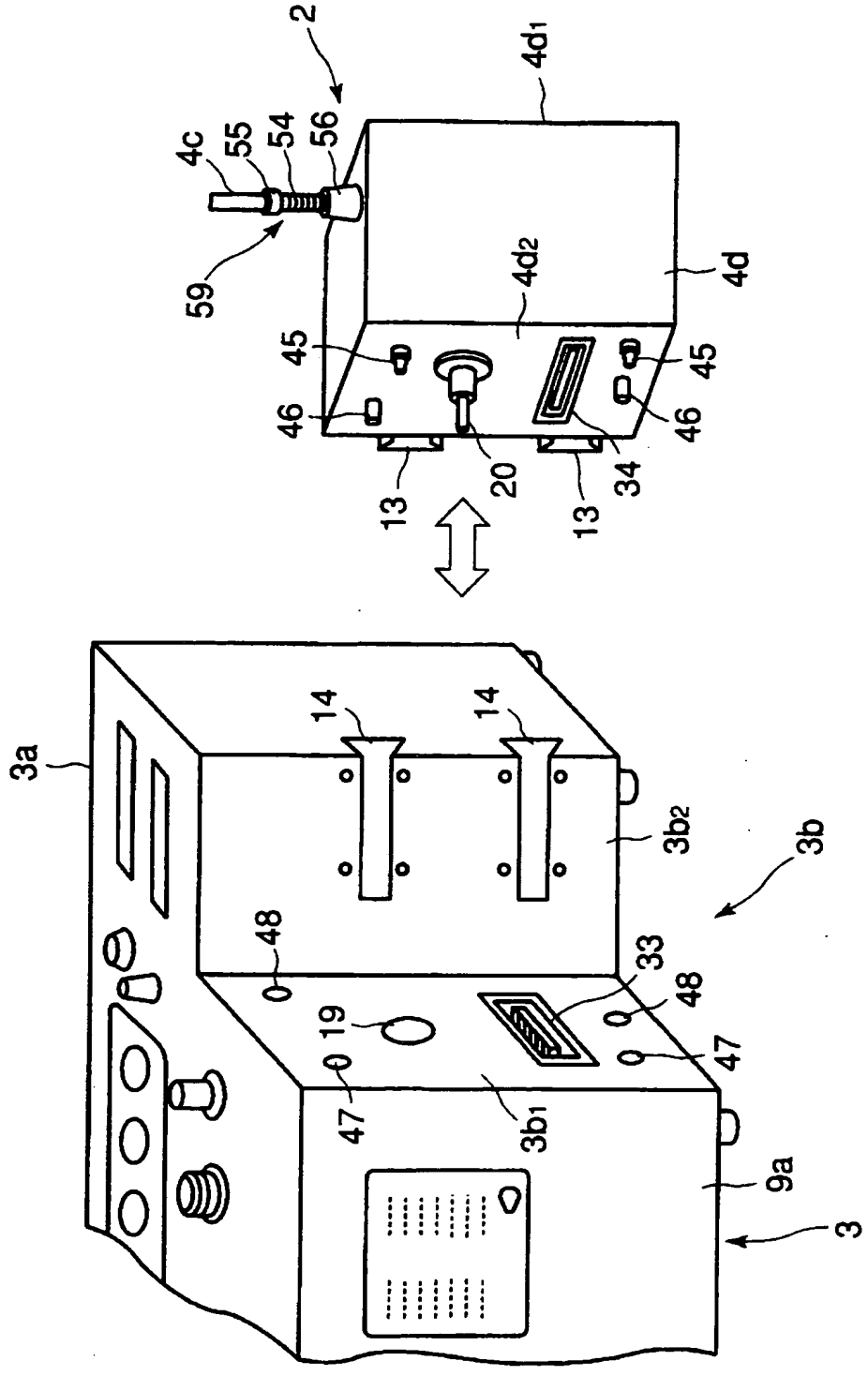
4a3
4a2
4b
1
2
4b1
4c
4b2
24
8
13
46
3
12
3b2
13
4d
14
45
4d1
20
34
4d2
14
13
9c
46
45
3a
9

【図３】

FIG. 3


2
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4c
55
54
56
59
4d2
4d
45
46
13
20
34
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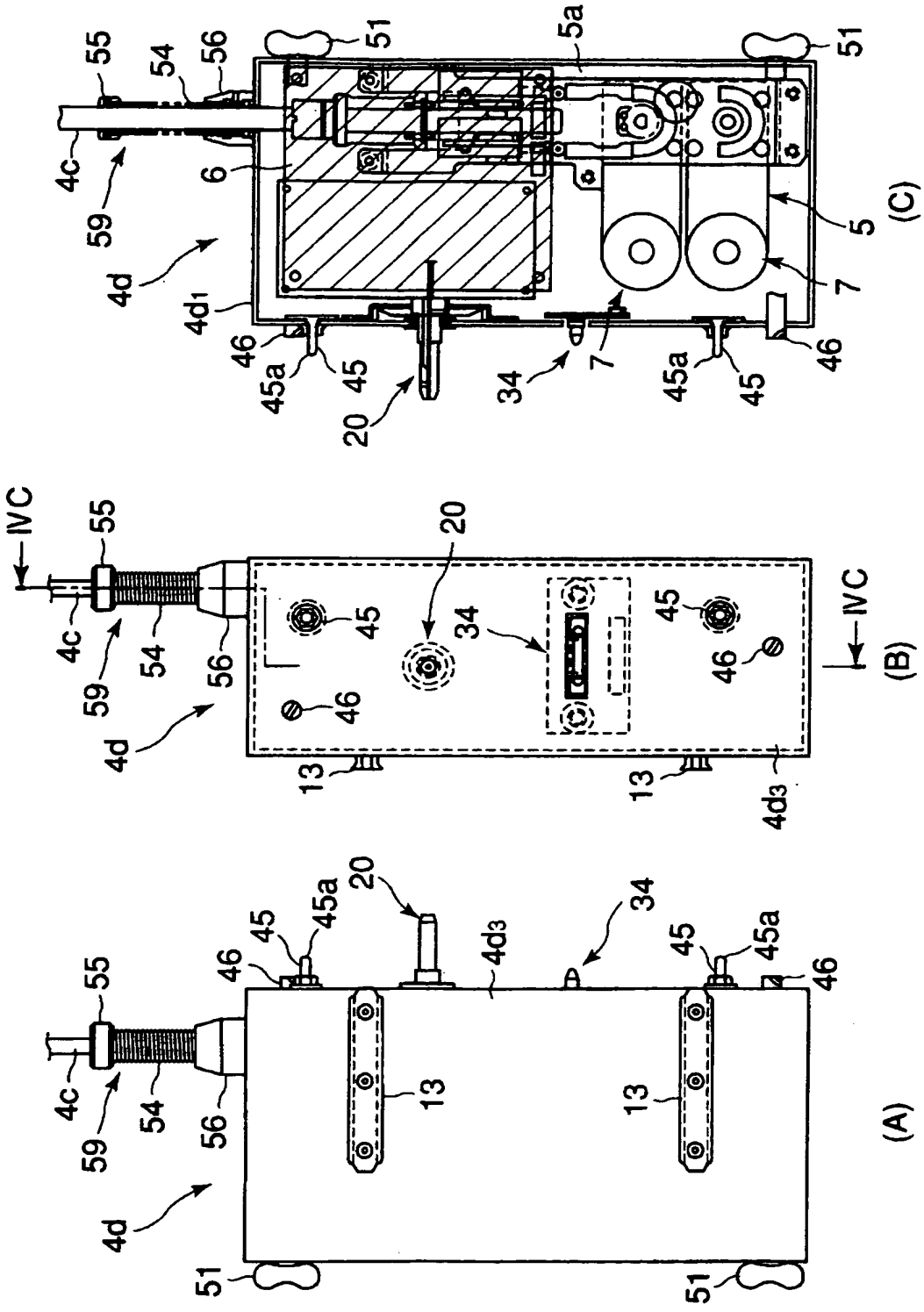
3b2
3b
48
33
19
47
3b1
9a
3

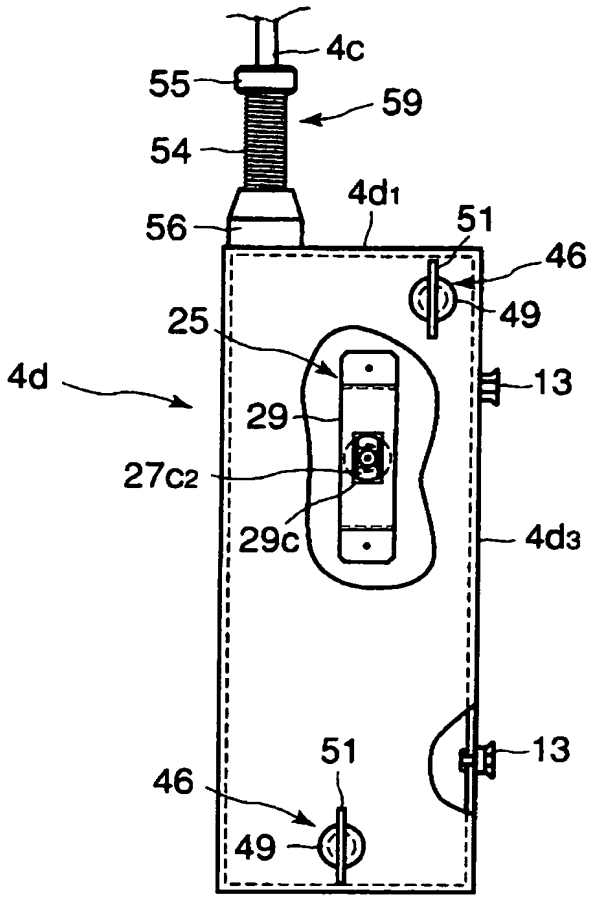
【図４】

FIG. 4



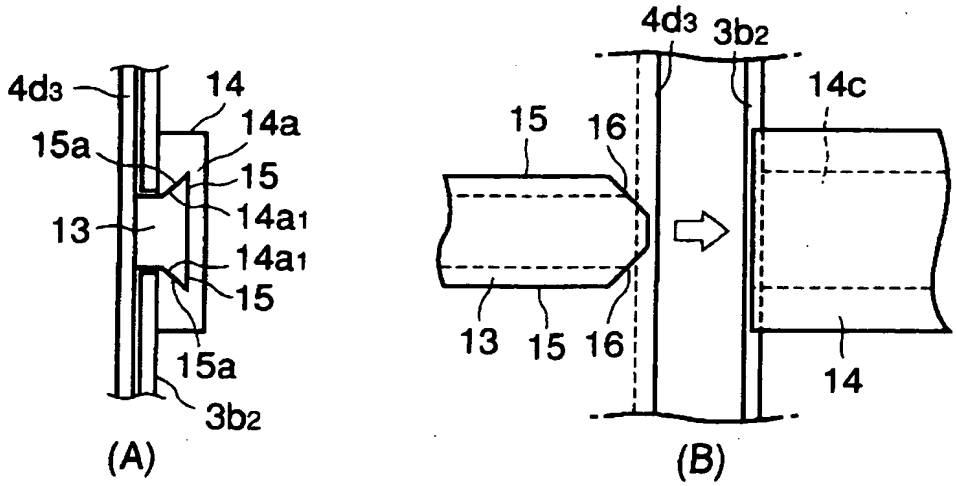
【図５】

FIG. 5



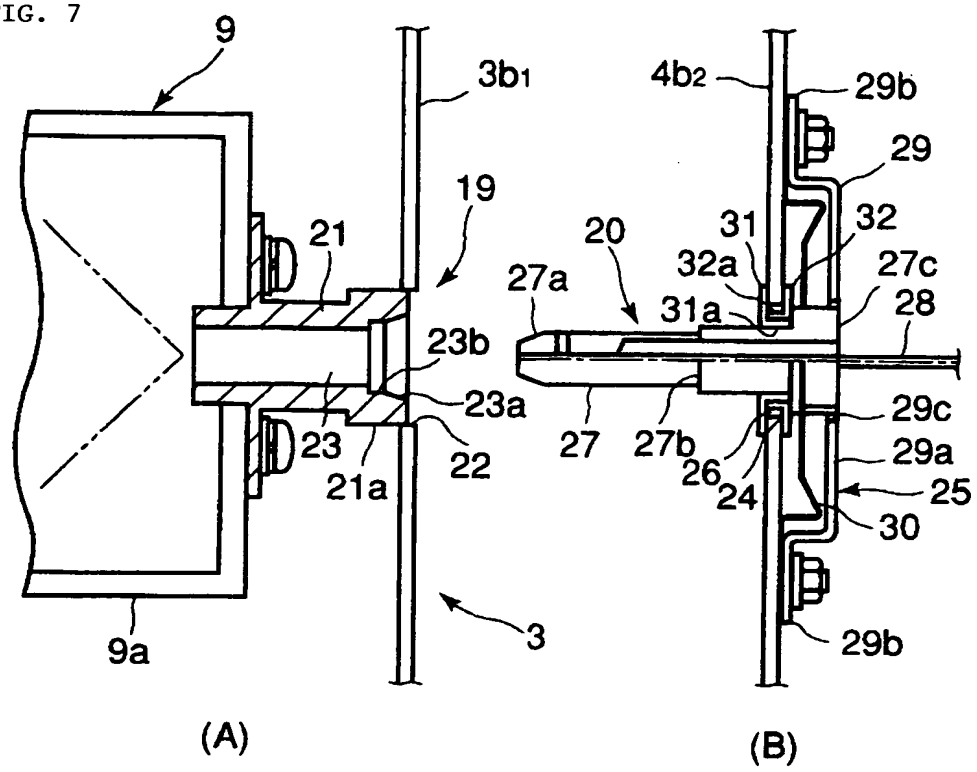
【図６】

FIG. 6



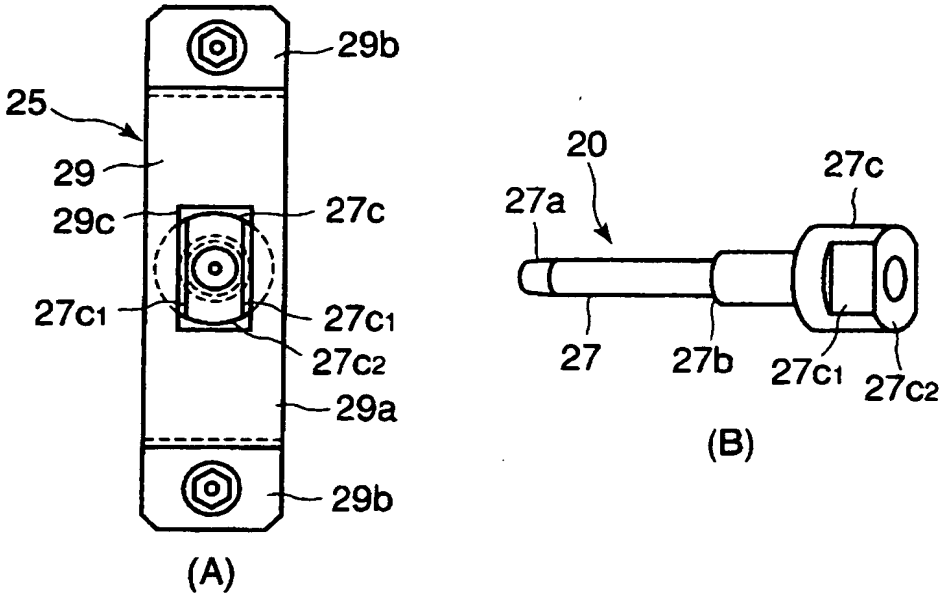
【図７】

FIG. 7



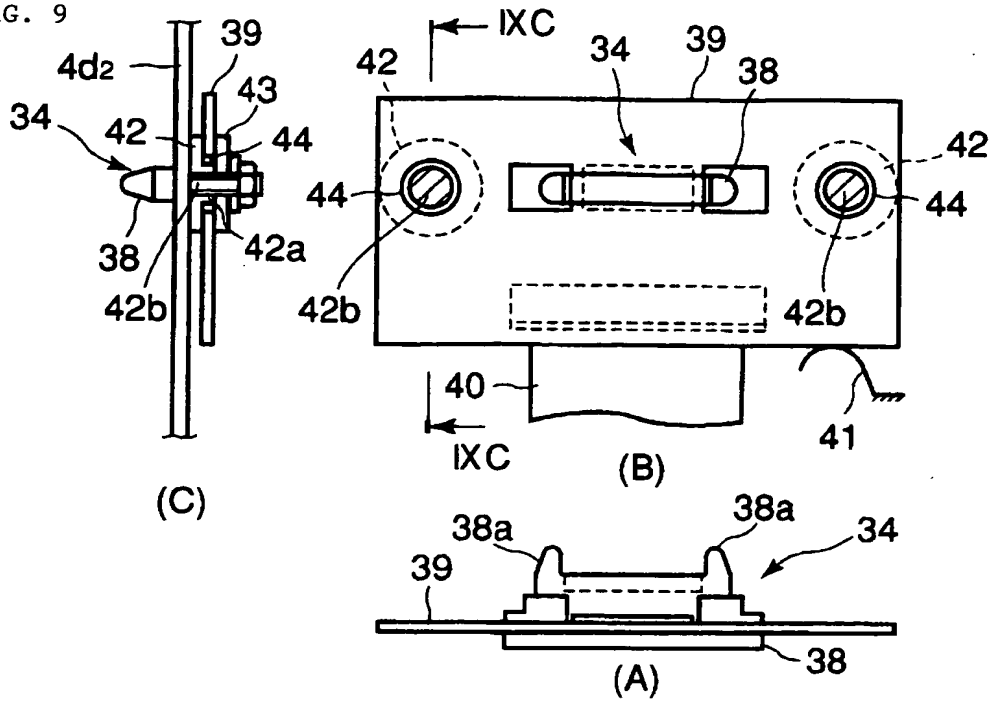
【図８】

FIG. 8



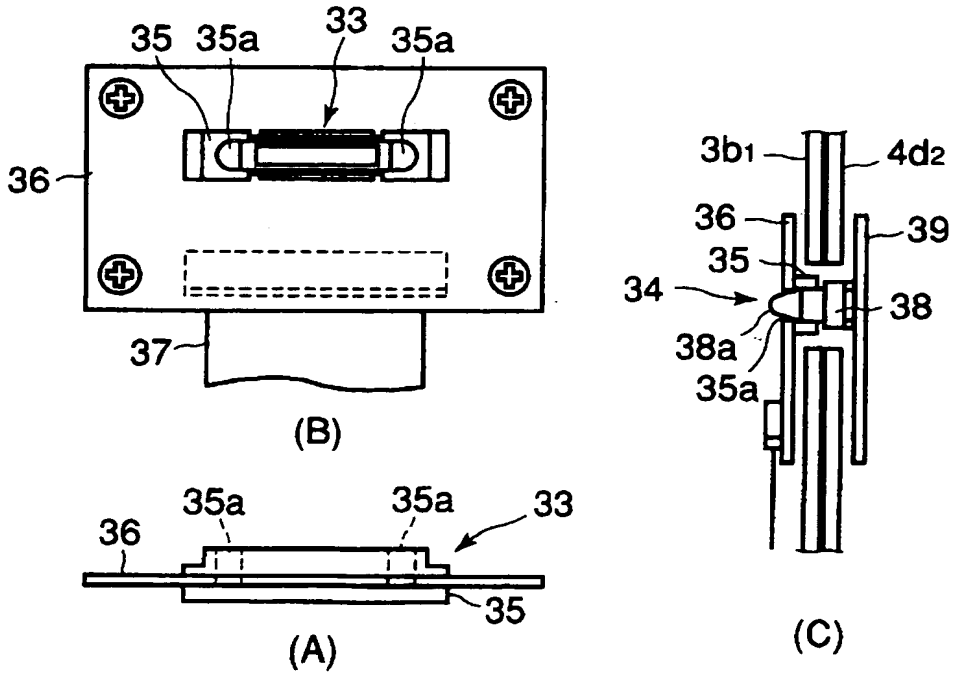
【図９】

FIG. 9



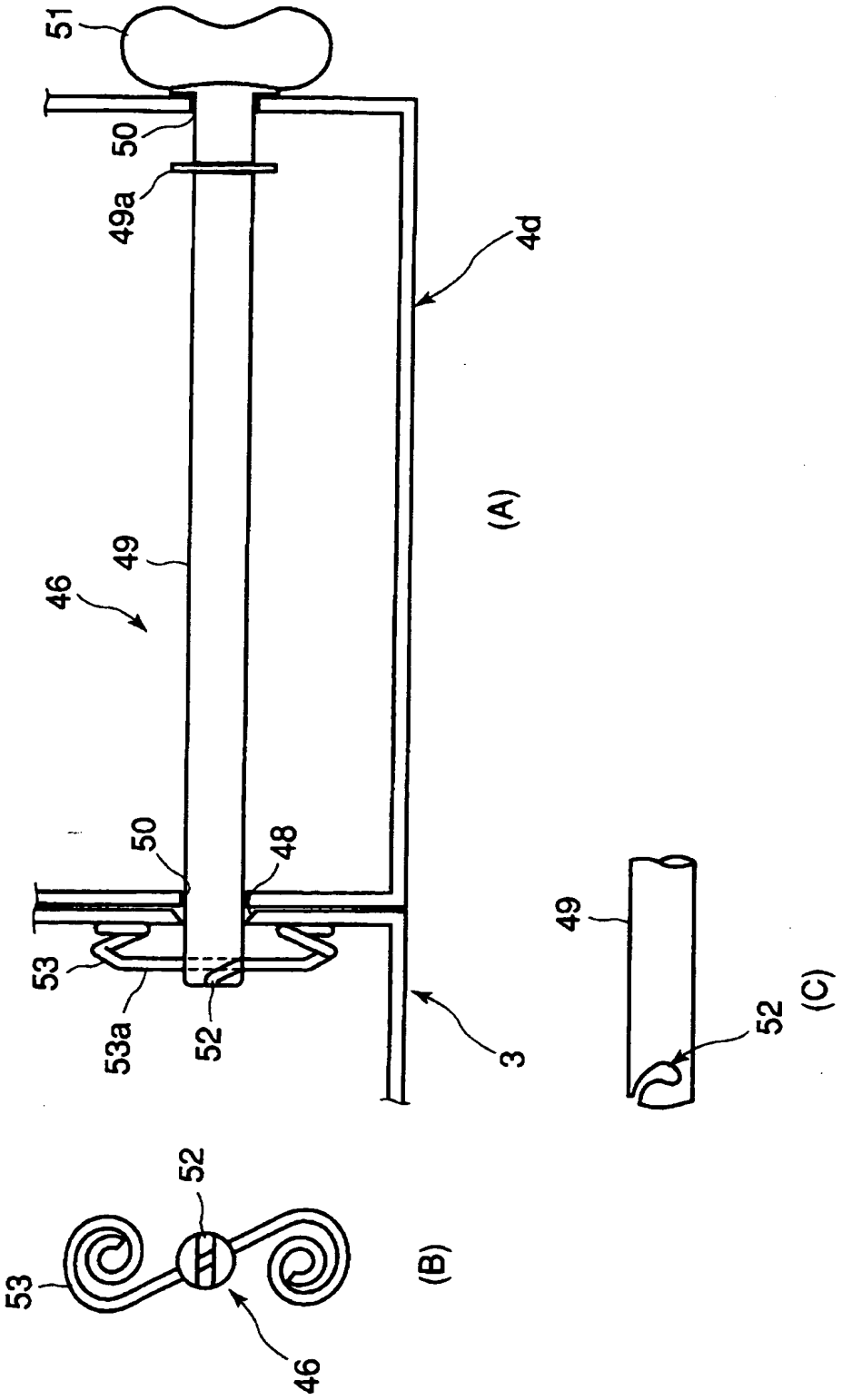
【図１０】

FIG. 10



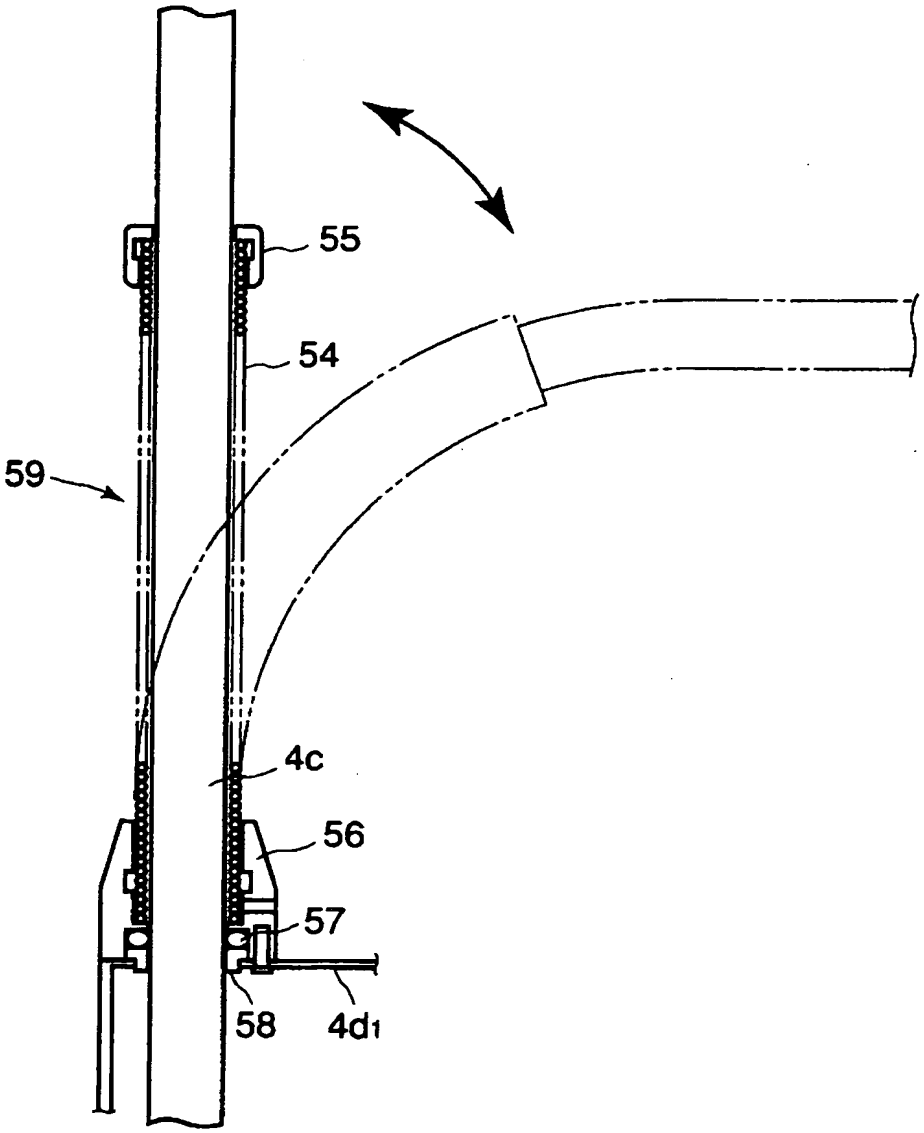
【図１１】

FIG. 11



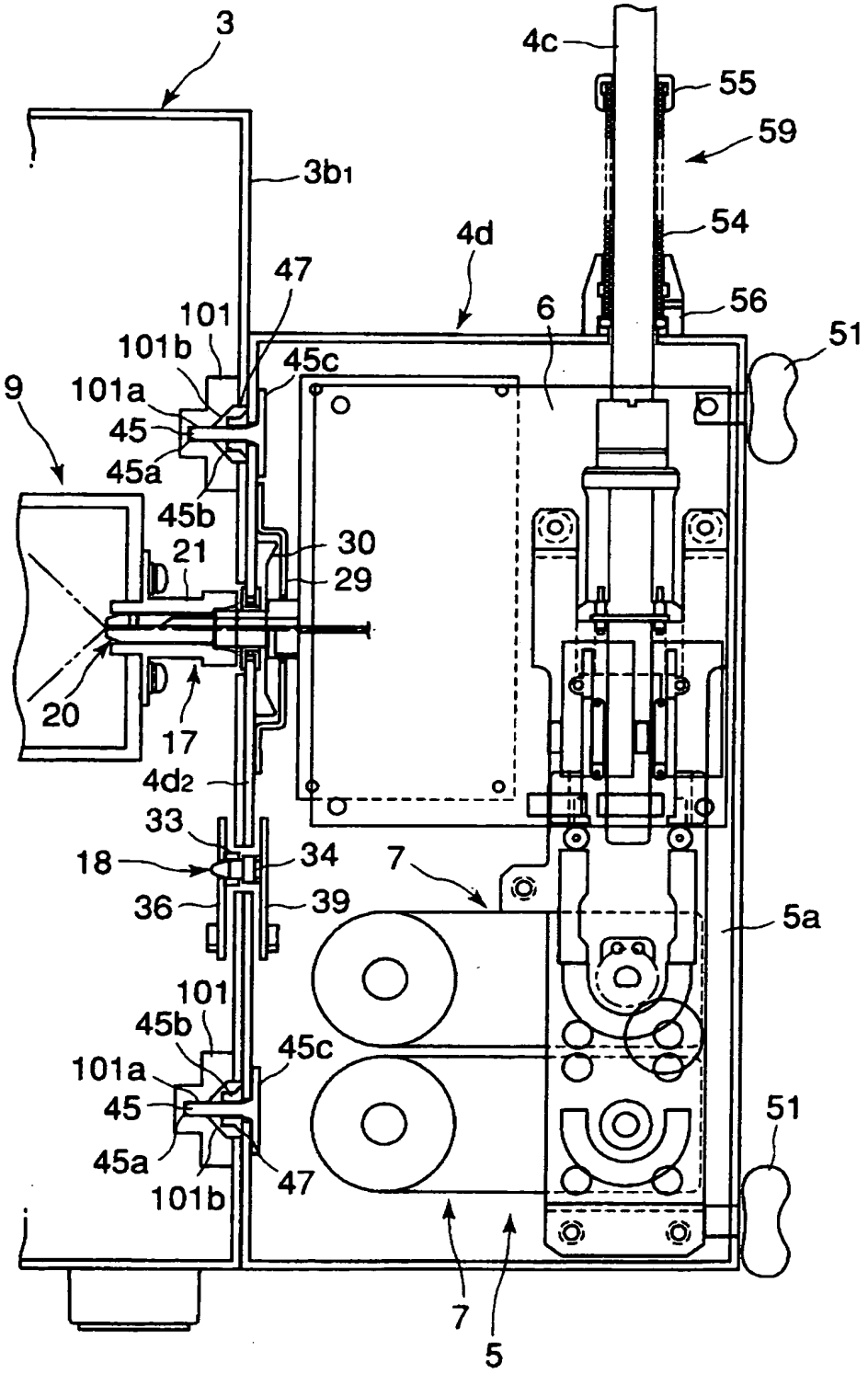
【図１２】

FIG. 12



【図１３】

FIG. 13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4d
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56
101
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101b
45c
9
101a
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21
30
29
20
17
4d2
33
18
34
7
36
39
5a
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45b
45c
101a
45
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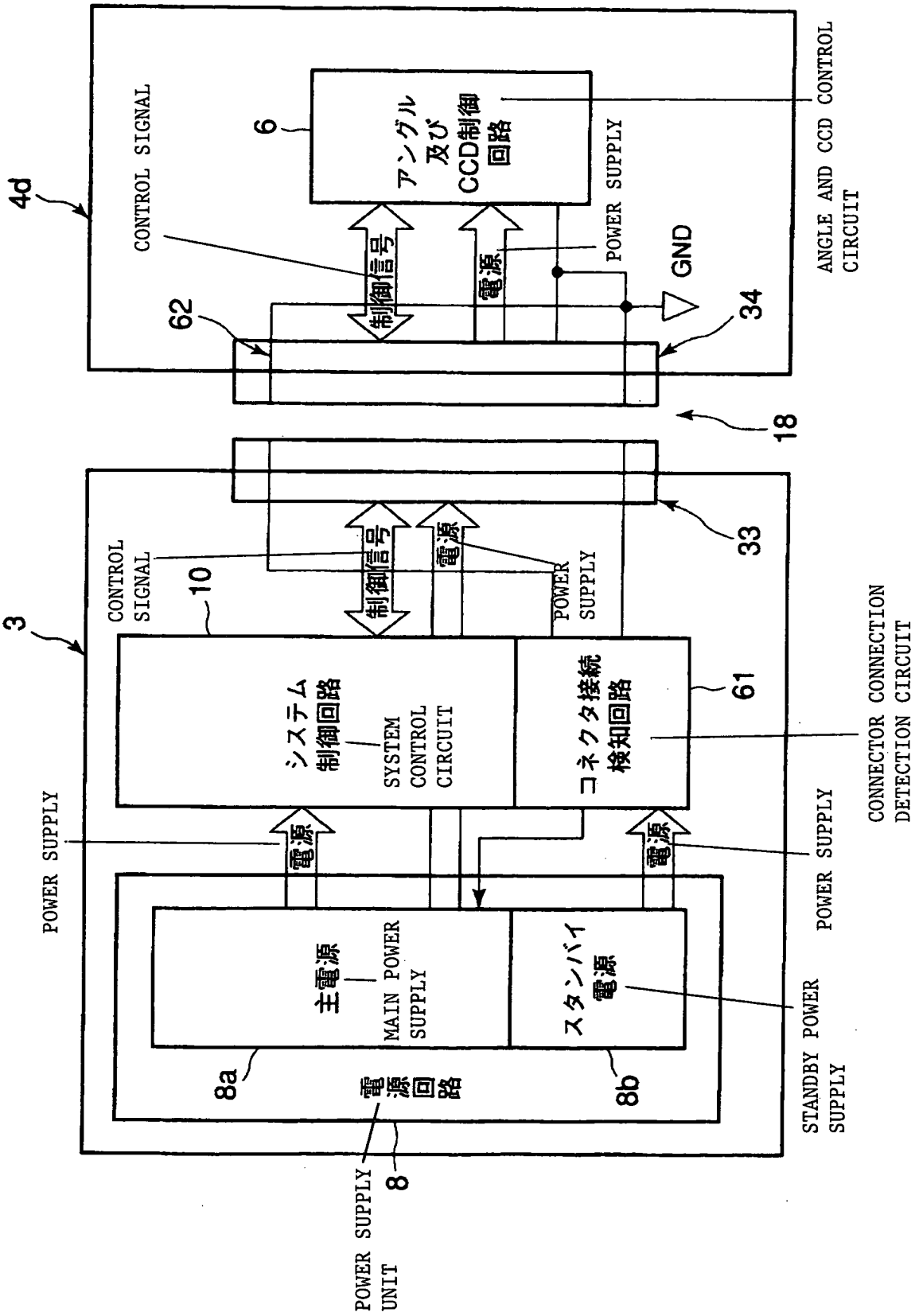
45a
47
101b
7
5

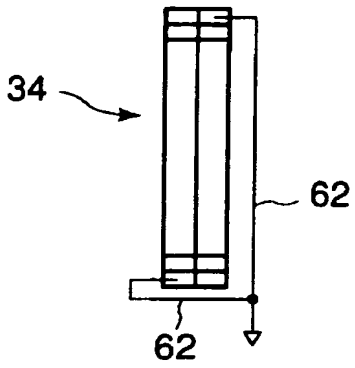
【図１４】

FIG. 14


4d
CONTROL SIGNAL
6
アングル及びCCD制御回路
制御信号
電源
POWER SUPPLY
GND
62
34
ANGLE AND CCD CONTROL CIRCUIT
18
33
3
CONTROL SIGNAL
10
制御信号
電源
POWER SUPPLY
システム制御回路
SYSTEM CONTROL CIRCUIT
コネクタ接続検知回路
61
CONNECTOR CONNECTION DETECTION CIRCUIT
POWER SUPPLY
電源
主電源
MAIN POWER SUPPLY
スタンバイ電源
STANDBY POWER SUPPLY
8a
8b
電源回路
8
POWER SUPPLY UNIT

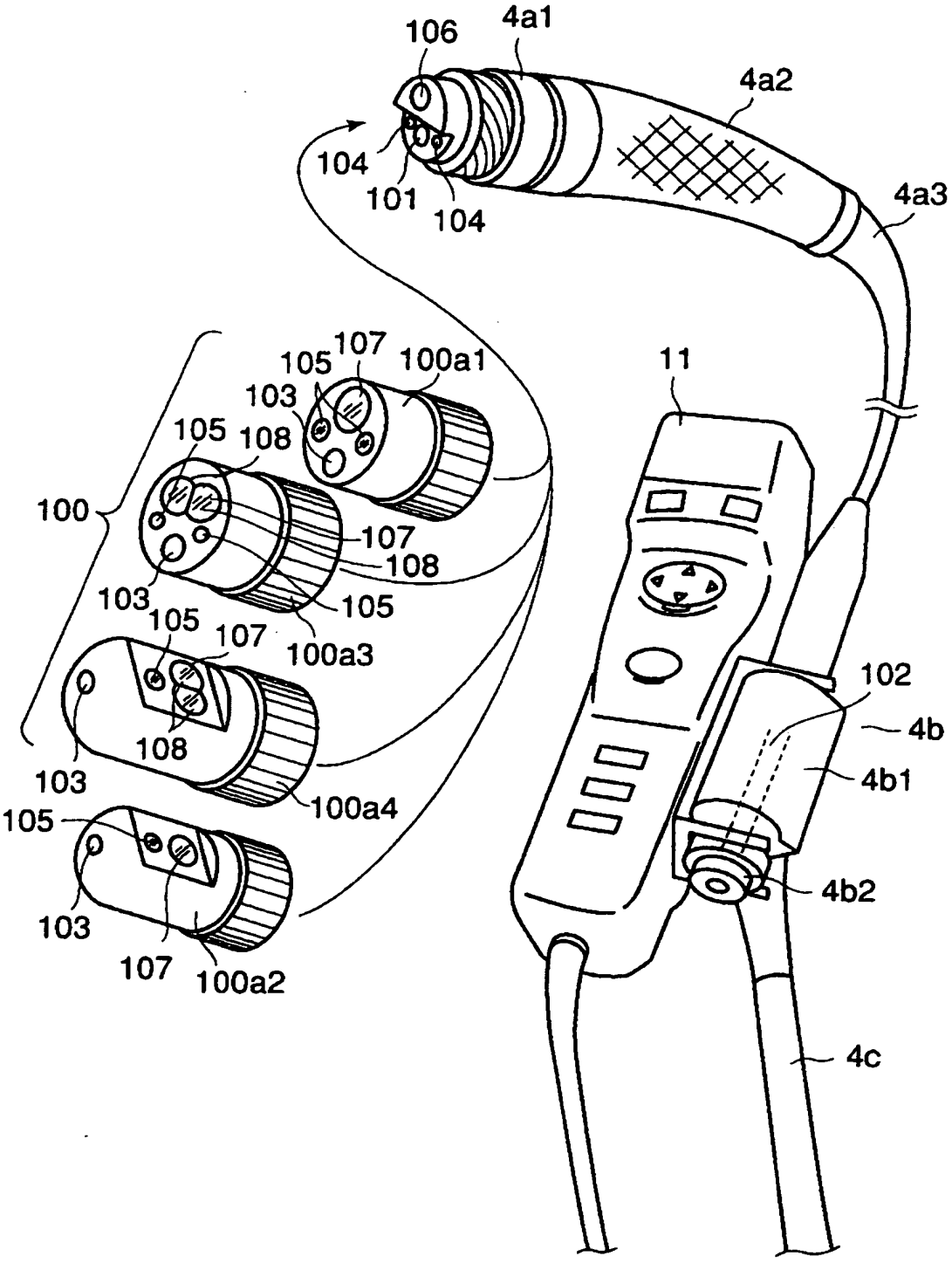
【図１５】

FIG. 15



【図１６】

FIG. 16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4a3
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100a1
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107
100a3
108
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100a4
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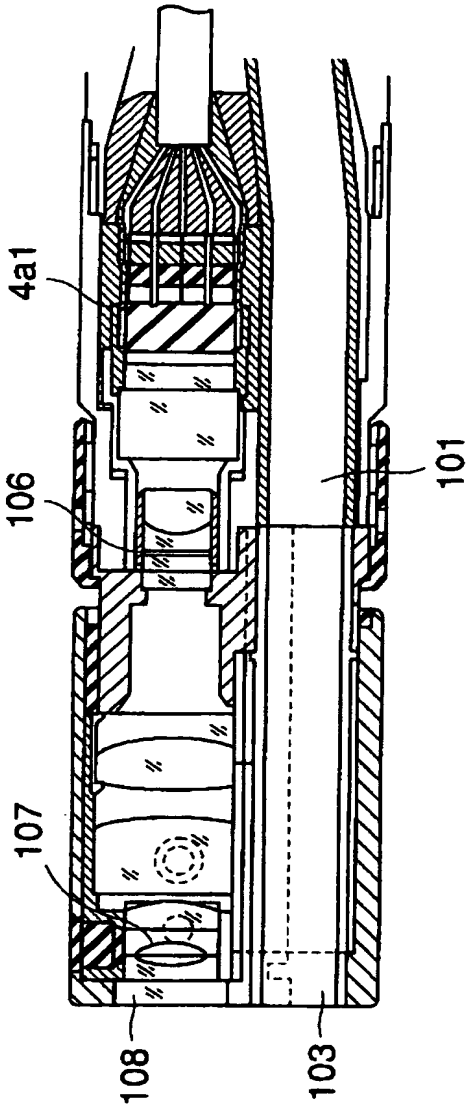
107
100a2
11
102
4b
4b1
4b2
4c

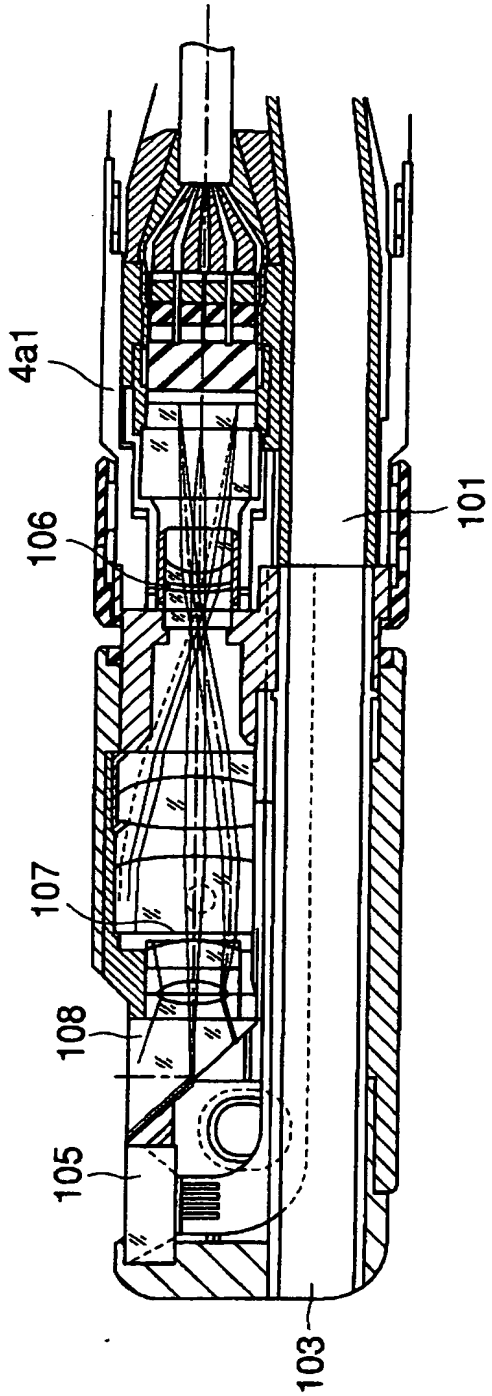
【図１７】

FIG. 17



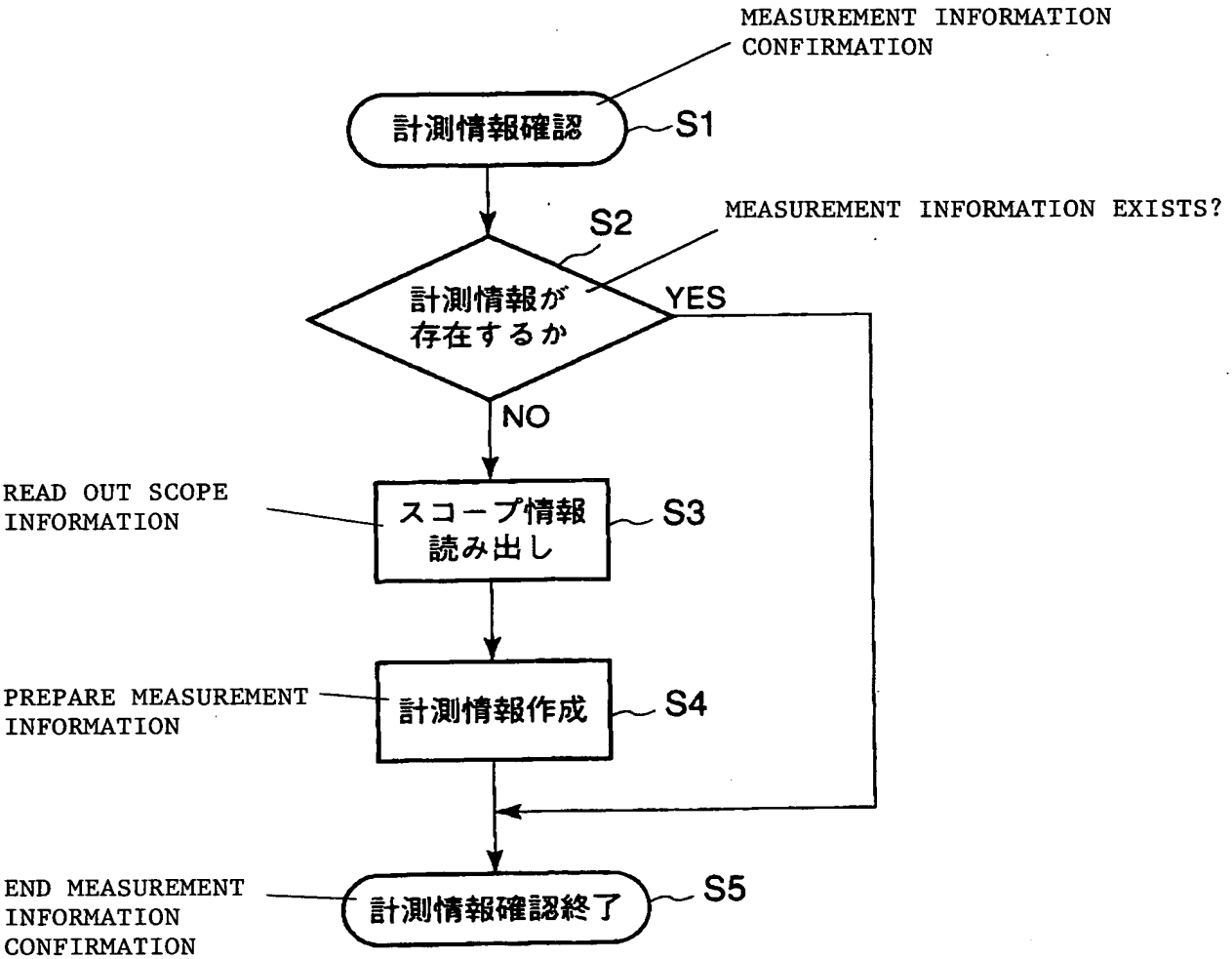
【図１８】

FIG. 18



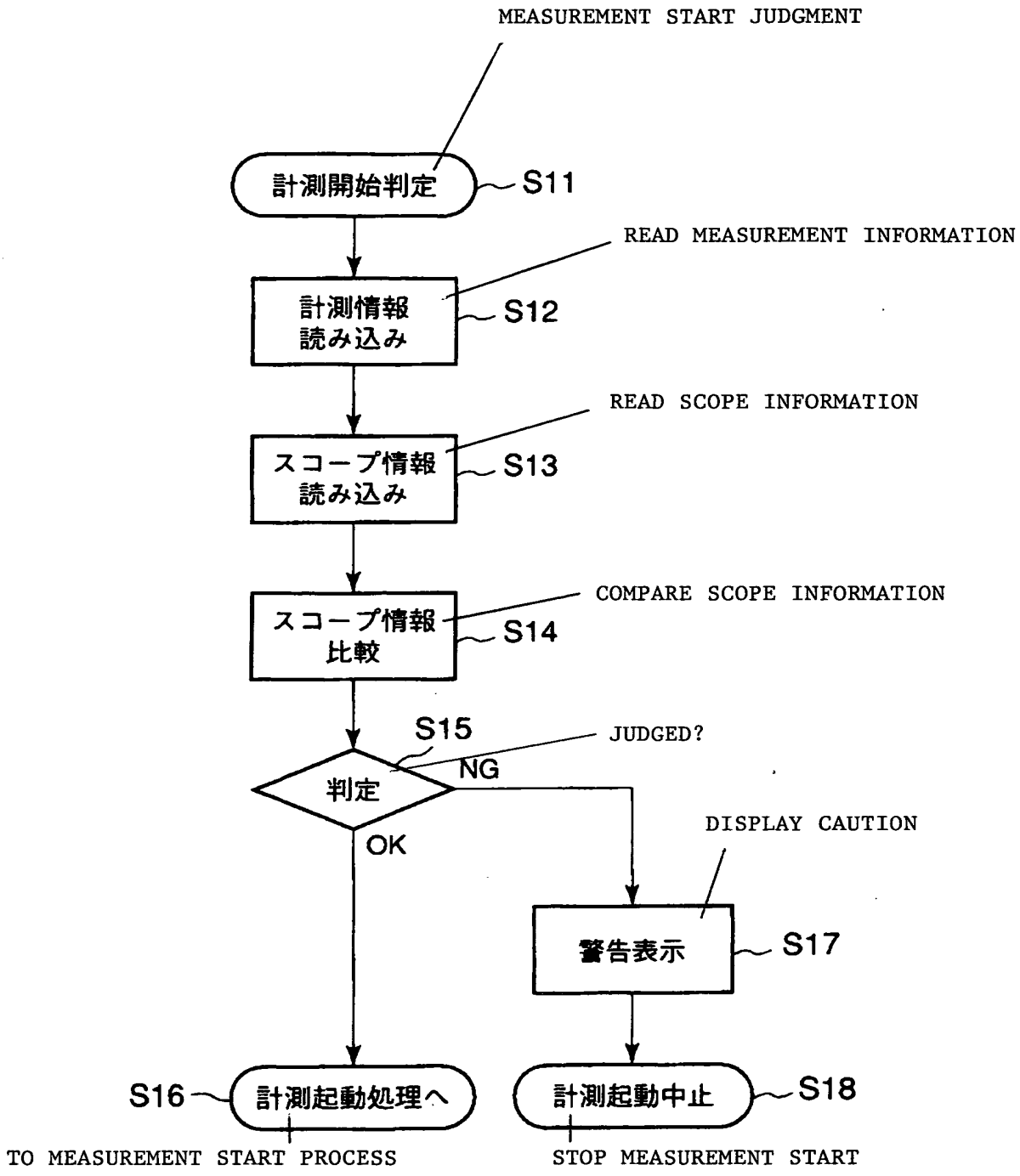
【図１９】

FIG. 19


MEASUREMENT INFORMATION CONFIRMATION
計測情報確認
S1
S2
MEASUREMENT INFORMATION EXISTS?
計測情報が存在するか
YES
NO
READ OUT SCOPE INFORMATION
スコープ情報読み出し
S3
PREPARE MEASUREMENT INFORMATION
計測情報作成
S4
END MEASUREMENT INFORMATION CONFIRMATION
計測情報確認終了
S5

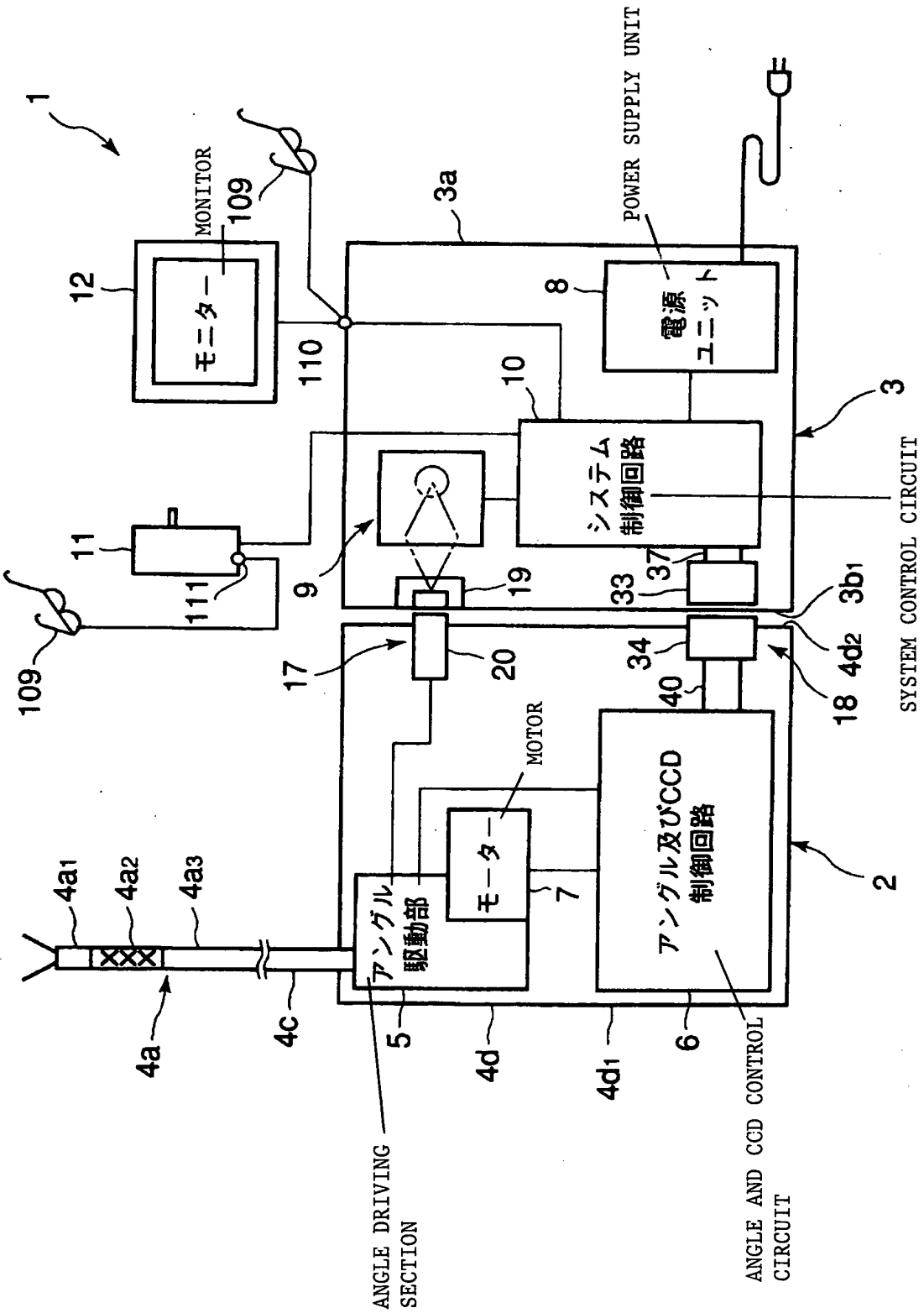
【図２０】

FIG. 20


MEASUREMENT START JUDGMENT
計測開始判定
S11
READ MEASUREMENT INFORMATION
計測情報
読み込み
S12
READ SCOPE INFORMATION
スコープ情報
読み込み
S13
COMPARE SCOPE INFORMATION
スコープ情報
比較
S14
S15
JUDGED?
判定
NG
OK
DISPLAY CAUTION
警告表示
S17
S16
計測起動処理へ
TO MEASUREMENT START PROCESS
計測起動中止
S18
STOP MEASUREMENT START

【図２１】

FIG. 21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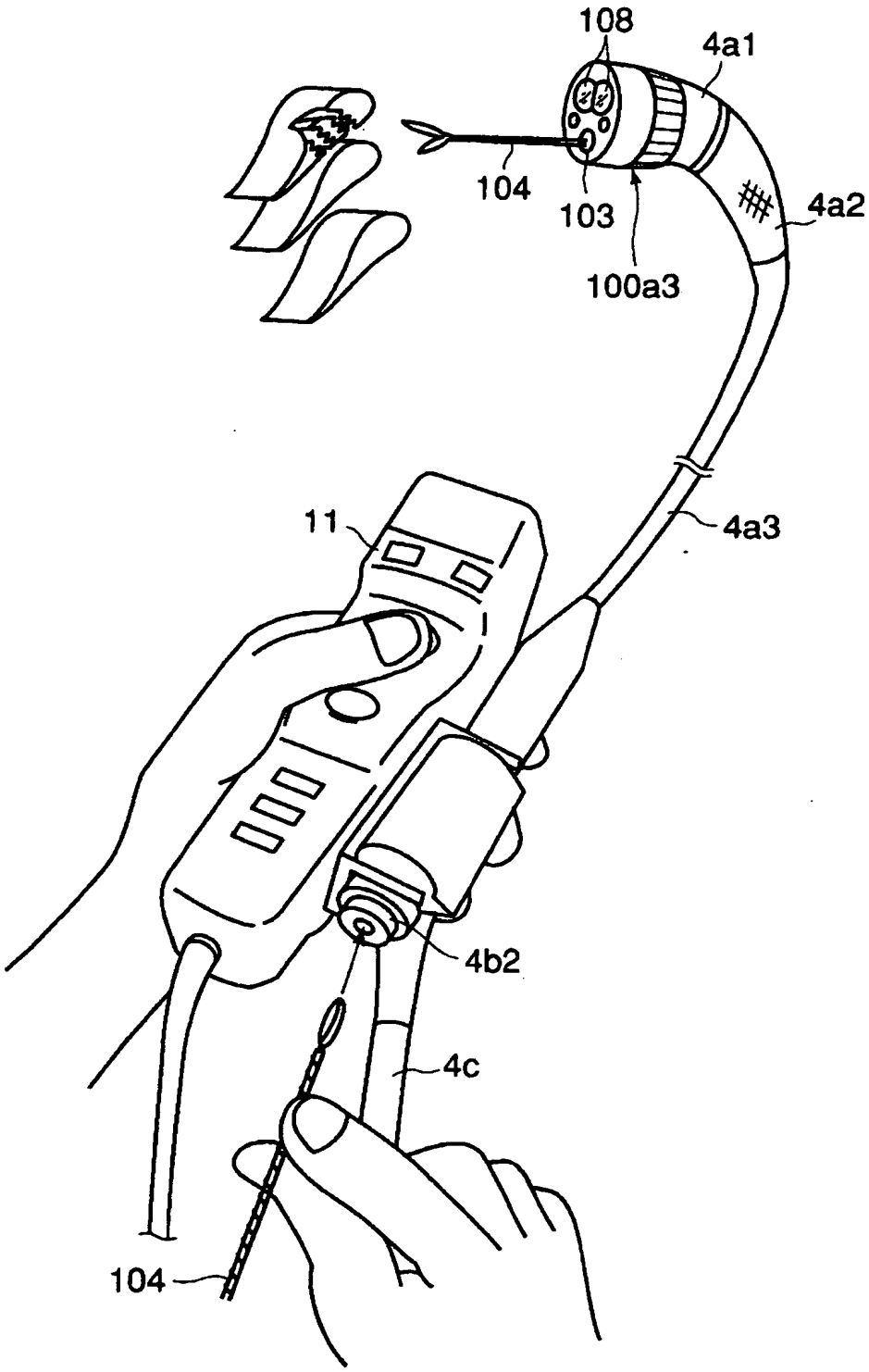
MONITOR
109
12
モニター
110
3a
POWER SUPPLY UNIT
8
電源ユニット
10
システム制御回路
3
SYSTEM CONTROL CIRCUIT
11
111
9
19
33
37
3b1
4d2
18
109
17
20
34
40
MOTOR
モーター
7
アングル及びCCD制御回路
2
4a1
4a2
4a3
4a
4c
アングル駆動部
5
4d
4d1
6
ANGLE DRIVING SECTION
ANGLE AND CCD CONTROL CIRCUIT

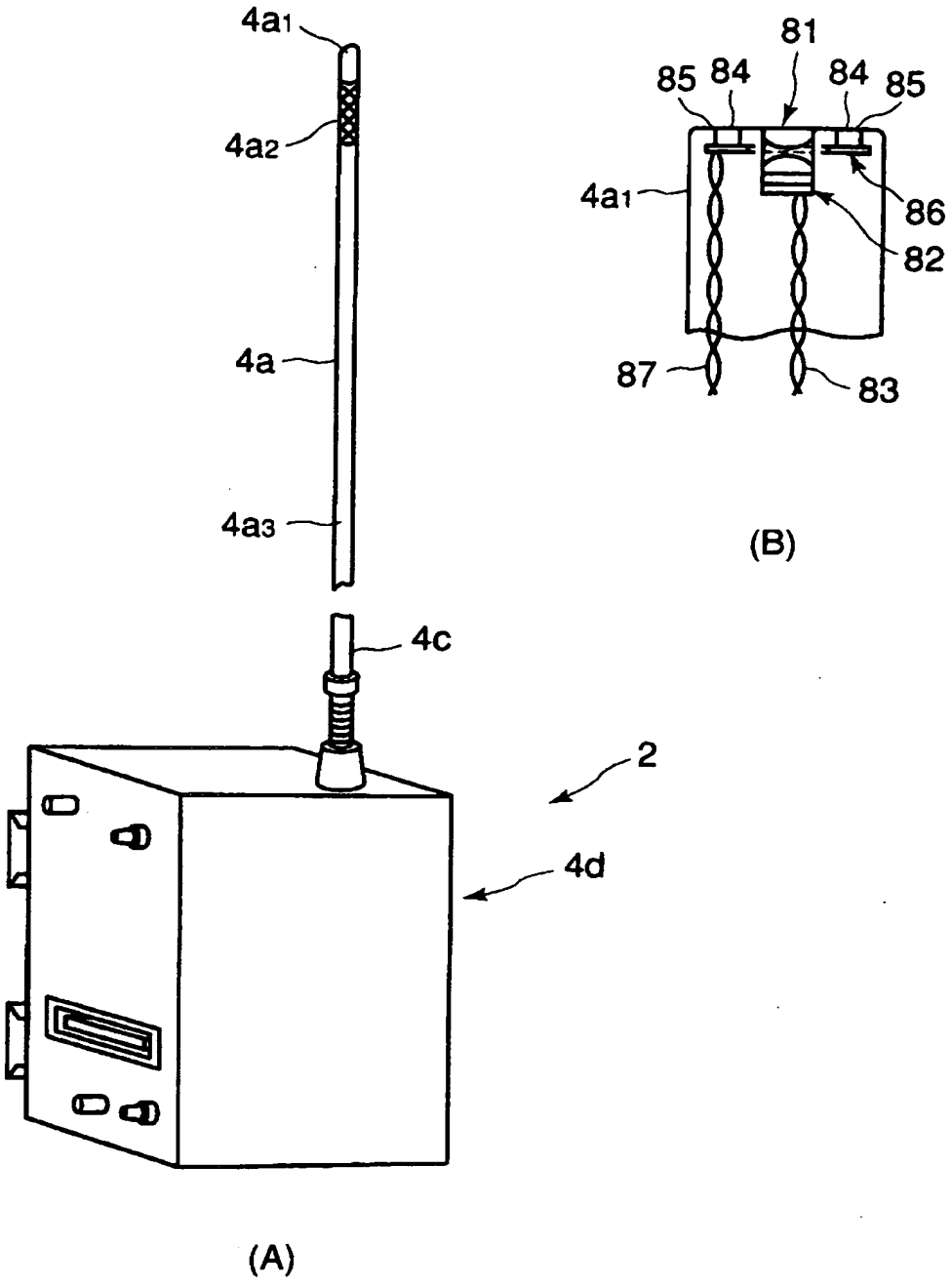
【図２２】

FIG. 22



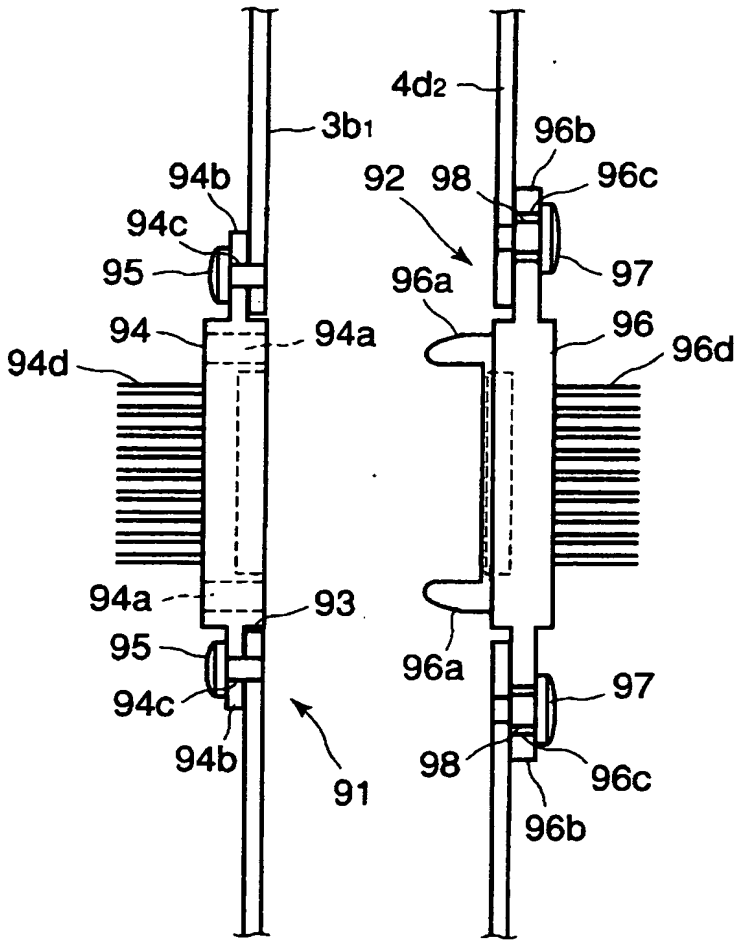
【図２３】

FIG. 23



【図２４】

FIG. 24


4d2
3b1
96b
94b
92
98
96c
94c
95
96a
97
94
94a
96
96d
94d
94a
93
95
96a
97
94c
94b
98
96c
91
96b

[Document] ABSTRACT

[Abstract]

[Object] The principal feature of the present invention is to provide an endoscope apparatus which can be used by combining a fixed unit with a plurality of types of scope units of external apparatus, thus enabling a sufficient performance to be exhibited through the compatibility and secure connection.

[Means for Achieving the Object] A fixed connector is provided in a standard position in a light source side optical connector 19 on the side of a fixed unit 3 in an optical connector portion 17 disposed in a detachable portion of a base unit 4d of a scope unit 2 and a fixed unit 3, and an LG connector main body 27 having a play portion 26 is provided to permit the backlash between both the connectors at the time of the attachment/detachment of an LG connector 20 on the side of the scope unit 2 with respect to the light source side optical connector 19. A tapered portion 27a of the LG connector main body 27 is fitted into a metal cap tapered portion 23a of the light source side optical connector 19, thereby carrying out axial alignment between both the light source side optical connector 19 and the LG connector 20 when connected.

[Elected Figure] FIG. 7

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